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FORESTRY, AGRICULTURE AND MARGINAL LAND

A Report by the Natural Resources (Technical) Committee

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The Committee wishes to record the debt which it owes to all those who have served on its working parties, who have presented papers, or who have attended to give evidence or advice at its meetings.

S. ZUCKERMAN,
Chairman.

January, 1957.

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Forestry, Agriculture and Marginal Land

INTRODUCTION

1. Products of the soil account for one half of the total import bill for the United Kingdom,⁽¹⁾ which in 1955 was about £3900 millions. We buy from abroad one half of all our food at a cost of £1250 millions; and we import upwards of 85 per cent of our requirements of timber and wood products⁽²⁾ at a cost of approximately £430 millions. These imports are crucial to the problem of our balance of payments. The importance of their reduction, where economically possible, and of the maximum economic use of our soil, needs no emphasis.

2. Over the past five years the Natural Resources (Technical) Committee has been considering what ways of increasing the use of indigenous sources of timber (cellulose) products are technically and economically feasible, and how any increases in the production of such products, for example through the extension of forestry, would affect the agricultural use of marginal land. Different aspects of this question have now been touched on in the recently published Reports of five other bodies. These are the reports of the Commission on Crofting Conditions in Scotland (Cmd. 9091), of the Welsh Agricultural Land Sub-Commission on mid-Wales (Cmd. 9631), of the Nature Conservancy for the year ended 30th September, 1955, of the Forestry Commission for the year ended 30th September, 1955, and of the Committee on Hedgerow and Farm Timber.⁽³⁾ In the report on crofting conditions it is stated that these outlying parts of Great Britain are in imminent danger of becoming completely depopulated, with a total loss of their agricultural output. In order to counteract this trend, the Commission recommended a number of measures of which one of the most important is that programmes of afforestation should be speeded up in the areas concerned. The report of the Welsh Agricultural Land Sub-Commission makes the same point. Once again attention is drawn to the occurrence of progressive depopulation, and to the value of afforestation in stabilizing population, and, indirectly, in helping to maintain agricultural output. These two enquiries thus highlight, for the particular areas with which they are concerned, a theme that may be applicable on a national scale to all our less populated areas. The Report of the Nature Conservancy expresses the view that the fertility of some of these areas has been seriously reduced. The Report on Hedgerow and Farm Timber contains a warning of the danger that this important source of hardwood timber is likely to become exhausted unless it is better managed than it now is. Finally the Forestry Commissioners' Report shows that a variety of factors are preventing the

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⁽¹⁾ While United Kingdom (Great Britain and Northern Ireland) figures are used in this paragraph it should be noted that the body of the report relates except where otherwise stated particularly to Great Britain.

⁽²⁾ i.e. wood and cork, paper and pulp, and rayon.

⁽³⁾ The report of the Committee on Marketing of Woodland Produce (H.M.S.O. 1956), which was published while the present report was in the press, presents yet another aspect of the problem. (See also footnote on p. 31).

Commissioners from maintaining a planting programme at the level which accords with the Commission's directive from the Government.

3. The purpose of the present report of the Natural Resources (Technical) Committee is to bring these separate conclusions into the perspective of a general study of the use to which the marginal land of Great Britain is now being, or could be put. In its examination of the problem, the Committee has been conscious of the fact that the density of population is falling fast in many outlying areas. Associated with this depopulation is a decline in the intensity of land use and, even more significant, a progressive deterioration of the fertility of the soil and of the vegetative cover. The more this trend continues, the less propitious become the possibilities of any future economic exploitation of our marginal acres. On the other hand, we have also reached the view that the isolated development of agriculture is not by itself an effective answer to all these problems; and that in some areas the amalgamation of farm units is a necessary corollary of economic development. The particular issue on which we have focussed our attention is the possibility that the integration of forestry with agriculture in certain districts might be more economically rewarding, and might have better social consequences, than would the independent development of either alone.

4. We realize that available information about the cost of and returns for this kind of investment is both meagre and heterogeneous, and that detailed investigation would be essential before any particular scheme was started. But we consider that enough evidence is already available to call for a reorientation, or a re-definition, of long-term national policy with regard to our marginal lands.

5. In the body of the Report which follows, we therefore review current policy on the use of land for agriculture and forestry, with particular reference to the less cultivated marginal areas; the prospects of supply and demand for food and forest products; the relative profitability of investment in farm and forestry; the possibilities of integrating agriculture and forest development; and the social benefits that might be expected to result from such an integration.

BACKGROUND AND OUTLOOK FOR AGRICULTURE

6. During the 1939–1945 war the goal of agricultural policy was to obtain the largest possible output of crops for direct human consumption, so as to economize in shipping space. To that end production of all fat livestock was curtailed, and emphasis was laid on the production of milk, not only for its "protective" value as a foodstuff, but because milk represents the most efficient conversion of grass into animal fat and protein. This policy had a very profound effect on the use of our farm lands, as is illustrated by the fact that in 1947 the area of tillage(1) was 12·2 million acres as compared with 8·7 million acres for the pre-war years. The increase was mainly in wheat and potatoes for human consumption, and in barley and other coarse grains for livestock. Because of the re-grassing of land least suitable for such crops,

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(1) i.e. crops and fallow. The figures for temporary grass are, pre-war 3·5 million acres, 1947 5·0 million acres, 1955 5·6 million acres.

the tillage acreage has since fallen, but it is still 2½ million acres more than it was before the war (i.e. 11·1 million as compared with 8·7 million acres).

7. The war also had a profound effect on the agricultural policies of the countries from which we imported foodstuffs; and, because of their increased domestic consumption, it became all too apparent that these countries could no longer be relied on to provide sufficient supplies of meat for the United Kingdom market in the immediate post-war years. The decision was therefore taken to increase the output of home-killed meat, which in turn meant a greater demand for feeding-stuffs. Here again supplies from foreign sources proved relatively scarce and expensive. The alternative to large imports was to maintain our wartime acreage of coarse grains, and to utilize to better advantage our large acreage of grass. The substitution of grass and grass products for the imported concentrates used in the feeding of ruminants enables coarse grains to be used for increasing the output of bacon, pork and eggs. By and large this policy has proved successful, and while there has been a fall in our cereal acreage from the peak figure of 1943, agricultural net output(1) at standardized prices, for the year 1955/56 was still 55 per cent above the pre-war level.

8. Once the post-war expansion programme took form, particularly with its emphasis on livestock, the contribution that the hill and upland livestock rearing areas could make was immediately apparent. Because of the war-time reduction in livestock production, these areas had been faring relatively badly, but schemes were initiated for rehabilitating holdings of hill land, and various grants and subsidies were provided as an incentive to increased production. The idea was that the upland areas should resume their traditional role of breeding sheep and cattle for finishing on lowland farms, since the integration of stock-raising on the uplands, where grass is the predominant crop, with fattening on lowland pastures, would put the total acreage devoted to livestock production to its maximum use.

9. Conditions have, however, changed since these plans were set in action. Food supplies entering into world trade have been unexpectedly plentiful in relation to effective demand; and with the currency available, there have been ample amounts of meat, cereals, and feeding-stuffs to buy. With the change in national policy over import controls, there has also been a corresponding diminution of the sense of urgency that we should produce the maximum of food from our own land. The emphasis is now on reducing costs of production, and at the same time curtailing the excessive usage of imported "concentrates" by making greater use of our indigenous resources of nutrition for livestock. Only in these two ways can we expect both to reduce the cost (which has now been running at over £200 millions per year for several years) of the elaborate system of agricultural grants and subsidies which sustain our agriculture, and at the same time to reduce our import bill for food.

10. At the same time, accepted agricultural policy continues to imply the need to retain for agriculture all that part of our land which is inherently capable of a high or moderate level of food production. If the better land is to achieve its optimum output of meat and milk, a sufficient supply of breeding and store animals must be forthcoming. This, as we shall argue later, in turn implies that the upland pastoral districts must be kept in production.

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(1) Net output in the sense of the gross sales off farm less imports of feeding-stuffs, seeds, and livestock for use on farms.

BACKGROUND AND OUTLOOK FOR FORESTRY AND FOREST PRODUCTS

TREND TOWARDS (PEACE-TIME) DEPENDENCE ON IMPORTS

11. Timber, being bulky, has always been more cheaply carried by water than overland, and was being imported into this country as long ago as the Middle Ages. Since then the exploitation of virgin forests has been a virtually continuous process, first in Eastern Europe, later in the Americas and elsewhere. Until recent years (except in time of war) it resulted in high grade timber always being available at our ports at low prices. As a result we have come to regard it as natural that in peace-time far and away the greatest proportion of our timber needs will be satisfied from abroad. This attitude has discouraged the maintenance of productive forests in this country. By 1936 home production of timber was below 5 per cent of consumption, and our capacity for sustained production was commensurately low. The following table briefly summarizes the situation.

TABLE 1 (1)

	1935/37 average	1953	1954	1955	1955 as % of pre-war
	('000 cubic feet solid volume of roundwood)				
I *Softwood* (including box-boards, excluding sleepers, crossings and poles)					
Production	20 628 (2)	12 879	15 660	13 635	66
Imports	645 408	398 844	408 753	472 770	
Consumption	663 039 (2)	363 906	422 550	439 317	66
II *Hardwood*					
Production	16 659 (2)	47 817	41 310	38 988	234
Imports	79 245	66 663	56 673	69 336	
Consumption	93 285 (2)	125 955	108 297	111 456	125
III *Mining timber*					
Production	6 291 (3)	32 913	41 391	41 229	655
Imports	127 089	58 995	52 488	45 495	
Consumption	126 009 (3)	92 637	92 448	92 448 (5)	73
TOTAL (I, II & III)					
Production	43 578	93 609	98 361	93 852	215
Consumption	882 333	582 498	623 295	643 221	73
Production as % of consumption	5	16	16	15	
IV *Pulpwood*					
Production	Not known	4 995	4 833	5 022	—
Imports	12 393	10 260	12 825	12 852	104
Consumption	13 932 (4)	16 983	18 792	17 172	123

(1) United Kingdom figures
(2) Estimated 1934/38 average
(3) Estimate
(4) 1939
(5) Provisional

Table 1 (1) (cont'd)

	1934/38 average	1953	1954	1955
V *Plywood* (including block-board, battenboard and laminated board)				
Production '000 cu. ft	138(2)	1 228	1 794	1 892
Imports ,, ,, ,,	12 458	5 197	11 708	15 134
(available for) Consumption	12 596(2)	11 984	14 471	14 523
VI *Fibre Building Board* (hard-board, insulating board, and laminated wallboard)				
Production '000 tons	16(2,3)	44	49	50
Imports ,, ,,	26	66	125	168
(available for) Consumption '000 tons	41(2)	108	172	216
VII *Woodpulp* (for papermaking and Industrial purposes)				
Production '000 tons	Not known	121	141	133
Imports ,, ,,	2 190(4)	1 604	1 918	2 244
Consumption ,, ,,	1 515(5)	1 815	2 023	2 206
VIII *Newsprint*				
Consumption '000 tons	1 209(6)	768	821	882

(1) United Kingdom figures
(2) Estimate
(3) 1935/38 average
(4) 1935/37 average
(5) 1939
(6) Average of 1934, 1935 and 1937

12. The destruction of the natural tree cover of Great Britain occurred mainly as a result of the clearing of land for agriculture, and as a consequence of the development of iron smelting in the days when charcoal was used for that purpose. The fact that trees were not planted elsewhere to take the place of the natural forest was simply a reflection of the fact that it was easier and cheaper to buy timber from abroad. On the other hand, from the 16th century onwards, Governments have occasionally encouraged the planting of high forest, particularly for ship building, as an insurance against the blockade of war: and we probably owe the fact that the British countryside was not completely denuded of trees to those private landowners who responded to this advice or who acted independently in the general interest. A firm national forest policy was not enunciated until 1918.

MILITARY/STRATEGIC CONCEPT

13. The basis of this policy was outlined in the 1918 Report of the Reconstruction Sub-Committee (Acland Committee) (Cmd. 8881). This Committee considered that it was desirable to create a reserve of standing timber which would be sufficient to assure three years' essential requirements in the event of war and the cessation of timber imports. To achieve this object it was considered necessary to afforest 1·77 million acres.

14. This programme was only in its early stages at the outbreak of war in 1939, and increased fellings had immediately to be resorted to because of the necessity to economize in shipping space, and because of the stopping of timber

well-known that we take it for granted largely, perhaps, because it is also in a measure true of some other industrialized countries. By far the bulk of our population, and most of our agricultural output, is concentrated in the "lowland" portion of Britain—leaving "Highland Britain" very sparsely populated and accounting for practically the whole of our marginal agricultural production. These little used areas of "Highland Britain" comprise the Highlands of Scotland, the Border country, the core of the Pennines and the Lake District, parts of South West England and most of Central and North Wales. The acreage concerned is almost one-third of the total land area of our country. To put the fact in even clearer light, whereas the national ratio of inhabitants to acres is 1 : 1, in the Scottish Highland Counties of Argyll, Inverness, Ross and Cromarty and Sutherland, which together cover some 8 million acres—almost one-seventh of the total land area of the United Kingdom—the ratio is less than 1 : 30. The corresponding figure for parts of the counties of Cardigan, Montgomery and Radnor, amounting to 715 000 acres, is one person for every 12 acres (see Appendix I).

VEGETATION AND FERTILITY

26. The reasons why production has not markedly increased in these areas in recent years are many and various. Most of our marginal land is remote from markets either in terms of actual distance or because of topographical difficulties of communication. Much of the area is at a considerable altitude, with steep contours, and subject to heavy rainfall. In consequence the soil is often thin and poor, with outcrops of bare rock. These physical characteristics are reinforced by historical and social factors such as the creation of private sporting reserves, the draining away of the younger and more enterprising of the population, the sub-division of original tenures into uneconomic holdings, and lack of capital for improvement.

27. The interplay of physical and human forces has affected, and will continue to affect, the fertility and the vegetation of these areas. The natural vegetation of a good deal of the area is woodland. When woodland is deliberately destroyed to permit of grazing, etc., an unstable ecology may be created. Without tree cover the fertility of the soil can only be maintained by the application of lime and fertilizers, particularly potash and phosphate, as well as by very careful management, including appropriate rates of stocking and, in some cases, regular, but not too frequent, burning of heather, etc. There are moors, which now hardly support a few sheep, that once provided grazing for cattle; and at an even earlier stage produced timber. In some hill districts fertility has fallen particularly low: and the process of leaching continues to impoverish the soil. In some hill districts where the situation is not quite as serious, deterioration continues through lack of good management and control of stock.

28. The importance of soil fertility and vegetative cover to the users of these marginal hill lands is obvious, but they may also have an indirect effect through water supply on production elsewhere. In other countries (where, admittedly, climatic variations are more violent) it is recognized that proper surface management of upland water-sheds is a factor in water supply and can assist the prevention of drought and flood. Hitherto we in this country have paid little attention to this question, but with the constant increase in demand for water for domestic, industrial and agricultural purposes, there is reason to consider

all means of keeping down the costs of supply, in terms both of money and of the land required for storage. Similar considerations apply to drainage and flood control. The regeneration of the vegetative cover of the remote uplands could have a beneficial effect on water control even in Great Britain. Further research (which the Nature Conservancy has already begun on a small scale) would be required to determine just how great the effects would be.

ECONOMIC IMPORTANCE OF INDIGENOUS RESOURCES

29. But apart from all this, we need to remind ourselves that a nation as dependent as is the United Kingdom on imports can ill afford to neglect the possible savings that might be obtained by the exploitation of the whole of its land resources.

30. At this moment we import most of the raw materials of industry and nearly half of the nation's food. Future expansion of the economy will require a greater supply of imports, and the extra imports will have to be paid for by a corresponding increase in exports. But there may well be considerable and persistent difficulty in achieving a satisfactory balance between imports and exports under condition of full-scale expansion, unless means are found of saving imports as well as of increasing exports. Any failure to achieve a satisfactory balance can only result in losses to the nation through a reduction in the rate of expansion. If import-saving enables a greater rate of expansion to take place than would otherwise be possible, there may be a gain to the nation even though the costs of the imports saved are less than the costs of the home production to replace them.

31. The difficulty of achieving a satisfactory balance between imports and exports will be aggravated by any movement against us in the terms of trade. The increase in world population which must be expected to continue for several generations, and the rising tempo of production and economic development all over the world, imply an increasing competition for available supplies of primary products. The richer and more accessible of the world's mineral deposits are being used up at an accelerating rate, and it is becoming increasingly difficult to find new areas of land to cultivate. While technical progress may help to increase productivity and secure greater economies in the use of materials, there is a risk that primary products will become increasingly scarce and costly relative to manufactured products. Since the United Kingdom, in the main, imports primary products and exports manufactures, this means that in the long run there is a danger that the terms of trade will turn against us.

32. On the general grounds of the problem of the balance of payments we therefore conclude that it would be imprudent to allow the wastage of our marginal land and the decline in its fertility to continue unchecked, as though it was a necessary and inevitable process.

RELATIVE SCALE OF THE MARGINAL LAND PROBLEM

33. Table II shows that 28·9 million of the 56·2 million acres of land surface of England, Scotland and Wales constitute cultivated farm land, including permanent pasture; 7·1 million acres are taken up by towns, industrial users, roads, railways and unclassified waste land: of the remainder, 16·2 million acres comprise "rough grazings" and 4·0 million are woodlands. The acreage listed as "rough grazings" includes lowland rough grazings, as well as hill grazings.

TABLE II

Land Use in Great Britain 1954

		Million Acres
Arable Land (including temporary grass)		16·9
Permanent Grass		12·0
Rough grazings		16·2
Woodlands (1)		
(a) Forestry Commission		
(i) planted	0·9	
(ii) plantable reserve	0·3	
(b) Private owners (existing woodlands)	2·6	
(c) Small woods (under five acres)	0·2	
Total		4·0
Unclassified (2)		7·1
Total land area		56·2

(1) Excludes hedgerow timber. The standing volume of hedgerow timber is estimated to be equivalent to that of a forest of about 300 000 to 400 000 acres.

(2) Includes land used for urban and factory development, roads, railways, quarries, and land unsuitable for forestry or agriculture.

CENTRAL PROBLEM OF MARGINAL LAND

34. The marginal or sub-marginal lands of Great Britain are made up of the 16·2 million acres of rough grazings together with a substantial part of the residual unclassified 7·1 million acres. It is accepted that a large part of this acreage could not be worked either for agriculture (except in the sense of very " extensive " grazing) or for forestry, except at an exorbitant expenditure of other resources. In the areas which can *just* be worked economically, i.e. the marginal areas, the same land has frequently been competed for by agriculture and forestry. It is this competition, and the attendant social issues, including depopulation, which we see as the central problem of the use of marginal land to-day. The agricultural claim to this land derives from the fact that much of it is already farm land; that, at present, it constitutes a breeding ground for cattle and sheep; and that it provides scope for the further expansion of the area under agriculture, given that economic or strategic conditions encourage or demand such expansion. For forestry, as we shall see later (paragraphs 56 to 68) our rough grazing land provides the main, almost the only possibility of completion or expansion of the tree planting programme.

AGRICULTURAL DEVELOPMENT OF MARGINAL LAND

PHYSICALLY MARGINAL LAND

35. Before we consider the development of marginal land we need to distinguish two issues, the first being the degree of fertility inherent in the soil, and the second the question of farm economics. Because of natural inequalities (e.g. in soil fertility, rainfall, elevation, aspect and drainage), the output of an acre of land in different parts of the country varies considerably. This variation is evident within the bounds of a single farm, and the differences between regions are frequently large. Thus the yield of grass expressed as " starch equivalent " varies from over 40 cwt per acre on improved lowland fattening pastures to 3 cwt per acre on rough hill grazings, and this in turn results in an output of meat per acre varying from over 200 lb to 15 lb. Differences in physical conditions are also responsible for the fact that the input of labour and capital needed to secure a given output of agricultural produce is not uniform, but increases as one progresses from better to poorer land.

ECONOMICALLY MARGINAL FARMS

36. Marginal land and marginal farming are not, of course, entirely synonymous terms, although they overlap to a considerable extent. Situated between the fertile lowlands and the rocky and uncultivable waste lands, our hill and upland farms are not only marginal physically but frequently marginal in the economic sense as well. To the agricultural economist a farm is marginal when its output is barely sufficient to reward the farmer with the equivalent of a farm worker's wage for the labour both of himself and his wife, together with a rate of interest on his capital which is the equivalent of the lowest alternative ruling rate. On this definition the term marginal land is an arbitrary one, as a farm might be made profitable through a reorganization of its boundaries, greater investment, improved farming techniques, or because of a rise in market prices.

MARGINAL LAND FARMING

37. There are also marked differences in management between our two major categories of marginal land farming. The farms in the "hill area" proper, which are mainly devoted to sheep, vary in size from a few hundred to several thousand acres, and the ratio of rough grazing to enclosed land is of the order of 8:1. The lower upland areas, frequently contiguous with the hill areas, are essentially devoted to livestock rearing, with the greater emphasis on cattle as opposed to sheep. The farms in these areas are much smaller and as a rule there is about one part of rough grazing to two parts enclosed land. These livestock rearing areas are inherently more fertile than the hill areas, and consequently are more suitable for improvement, although a greater proportion may be economically marginal.

38. Any farmer on marginal land suffers two severe economic limitations. His output consists mainly of store sheep or cattle, and is usually not sold directly to the butcher, but for crossing or fattening on lowland farms. Hence this kind of farmer does not enjoy at first hand the advantages of guaranteed prices and markets for end-products that applies to the lowland farmer. Secondly he cannot switch, as can the lowland farmer, from one enterprise to another according to the demand of the market, for hardly any agricultural crop except grass is suitable for these hill and upland farms. Apart from these handicaps, a great many upland marginal farms are too small—in relation to their natural fertility and other "natural" factors—to support the costs of modern living amenities for the farmer's family and for any farm workers who may be employed: and by the same token too small to enable a portion of the income to be set aside for investment in improvement with a view to increasing output.

AGRICULTURAL IMPROVEMENT

39. That improvement in output is, however, possible is shown by a survey of upland livestock rearing farms that was carried out in 1949 by the Agricultural Research Council and the Ministry of Agriculture and Fisheries. Particular areas of rough grazings—which before improvement produced 3 cwt starch equivalent per acre—gave 12 cwt per acre after improvements, thus enabling the stock carrying capacity of the improved land to be increased three to four-fold: while for a farm as a whole there was an increase in output from an average of 7 cwt starch equivalent per acre, sufficient to carry only one beast on 4 acres, to over 11 cwt starch equivalent per acre, which allowed a stocking of about one and a half mature beasts per 4 acres. On the other hand, the "marginality" of these farms under present standards of management, and

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(c) Small woods (under five acres)	0·2	
Total		4·0
Unclassified (2)		7·1
Total land area		56·2

(1) Excludes hedgerow timber. The standing volume of hedgerow timber is estimated to be equivalent to that of a forest of about 300 000 to 400 000 acres.

(2) Includes land used for urban and factory development, roads, railways, quarries, and land unsuitable for forestry or agriculture.

CENTRAL PROBLEM OF MARGINAL LAND

34. The marginal or sub-marginal lands of Great Britain are made up of the 16·2 million acres of rough grazings together with a substantial part of the residual unclassified 7·1 million acres. It is accepted that a large part of this acreage could not be worked either for agriculture (except in the sense of very " extensive " grazing) or for forestry, except at an exorbitant expenditure of other resources. In the areas which can *just* be worked economically, i.e. the marginal areas, the same land has frequently been competed for by agriculture and forestry. It is this competition, and the attendant social issues, including depopulation, which we see as the central problem of the use of marginal land to-day. The agricultural claim to this land derives from the fact that much of it is already farm land; that, at present, it constitutes a breeding ground for cattle and sheep; and that it provides scope for the further expansion of the area under agriculture, given that economic or strategic conditions encourage or demand such expansion. For forestry, as we shall see later (paragraphs 56 to 68) our rough grazing land provides the main, almost the only possibility of completion or expansion of the tree planting programme.

AGRICULTURAL DEVELOPMENT OF MARGINAL LAND

PHYSICALLY MARGINAL LAND

35. Before we consider the development of marginal land we need to distinguish two issues, the first being the degree of fertility inherent in the soil, and the second the question of farm economics. Because of natural inequalities (e.g. in soil fertility, rainfall, elevation, aspect and drainage), the output of an acre of land in different parts of the country varies considerably. This variation is evident within the bounds of a single farm, and the differences between regions are frequently large. Thus the yield of grass expressed as " starch equivalent " varies from over 40 cwt per acre on improved lowland fattening pastures to 3 cwt per acre on rough hill grazings, and this in turn results in an output of meat per acre varying from over 200 lb to 15 lb. Differences in physical conditions are also responsible for the fact that the input of labour and capital needed to secure a given output of agricultural produce is not uniform, but increases as one progresses from better to poorer land.

ECONOMICALLY MARGINAL FARMS

36. Marginal land and marginal farming are not, of course, entirely synonymous terms, although they overlap to a considerable extent. Situated between the fertile lowlands and the rocky and uncultivable waste lands, our hill and upland farms are not only marginal physically but frequently marginal in the economic sense as well. To the agricultural economist a farm is marginal when its output is barely sufficient to reward the farmer with the equivalent of a farm worker's wage for the labour both of himself and his wife, together with a rate of interest on his capital which is the equivalent of the lowest alternative ruling rate. On this definition the term marginal land is an arbitrary one, as a farm might be made profitable through a reorganization of its boundaries, greater investment, improved farming techniques, or because of a rise in market prices.

MARGINAL LAND FARMING

37. There are also marked differences in management between our two major categories of marginal land farming. The farms in the "hill area" proper, which are mainly devoted to sheep, vary in size from a few hundred to several thousand acres, and the ratio of rough grazing to enclosed land is of the order of 8:1. The lower upland areas, frequently contiguous with the hill areas, are essentially devoted to livestock rearing, with the greater emphasis on cattle as opposed to sheep. The farms in these areas are much smaller and as a rule there is about one part of rough grazing to two parts enclosed land. These livestock rearing areas are inherently more fertile than the hill areas, and consequently are more suitable for improvement, although a greater proportion may be economically marginal.

38. Any farmer on marginal land suffers two severe economic limitations. His output consists mainly of store sheep or cattle, and is usually not sold directly to the butcher, but for crossing or fattening on lowland farms. Hence this kind of farmer does not enjoy at first hand the advantages of guaranteed prices and markets for end-products that applies to the lowland farmer. Secondly he cannot switch, as can the lowland farmer, from one enterprise to another according to the demand of the market, for hardly any agricultural crop except grass is suitable for these hill and upland farms. Apart from these handicaps, a great many upland marginal farms are too small—in relation to their natural fertility and other "natural" factors—to support the costs of modern living amenities for the farmer's family and for any farm workers who may be employed: and by the same token too small to enable a portion of the income to be set aside for investment in improvement with a view to increasing output.

AGRICULTURAL IMPROVEMENT

39. That improvement in output is, however, possible is shown by a survey of upland livestock rearing farms that was carried out in 1949 by the Agricultural Research Council and the Ministry of Agriculture and Fisheries. Particular areas of rough grazings—which before improvement produced 3 cwt starch equivalent per acre—gave 12 cwt per acre after improvements, thus enabling the stock carrying capacity of the improved land to be increased three to four-fold: while for a farm as a whole there was an increase in output from an average of 7 cwt starch equivalent per acre, sufficient to carry only one beast on 4 acres, to over 11 cwt starch equivalent per acre, which allowed a stocking of about one and a half mature beasts per 4 acres. On the other hand, the "marginality" of these farms under present standards of management, and

within the existing price structure, is demonstrated by the fact that, after a capital expenditure of about £30 per acre (including substantial expenditure on buildings, roads, etc.), the value of the increased production, equivalent to 4 cwt starch equivalent per acre, was worth at 1949 prices just over £4. This increase in output was roughly equal to the increased annual cost after carrying out improvements.

40. A further survey of hill and livestock rearing farms was made by the Agricultural Research Council and the Ministry in 1953–54. This indicated that there had been a general increase in the stock carrying capacity of farms assisted under the Hill Farming and Livestock Rearing Acts. On particular areas of rough grazing previously carrying 0·2 beasts per acre, improvement had increased stock carrying capacity by 0·36 beasts per acre in Wales at a cost of £18 per acre, and by 0·25 beasts per acre in England at a cost of £11 per acre (these costs being for field works only). To the nation the return on *all* work approved under these two Acts (which includes a substantial investment in fixed equipment) is estimated to be around 1 per cent per annum. Further improvements (additional to those already approved under the Acts, and with a greater bias toward improvement of fertility rather than provision of fixed equipment) could yield the nation a return of some 3½ per cent on the additional capital invested. Allowing for aid under the Acts, the return to the farmer on the concomitant private investment would probably be about 10 to 12 per cent. As these figures suggest, the return on capital invested in reclaiming enclosed rough grazing, where improvement is restricted to cultivation only, is initially greater than when improvement includes buildings. A survey of the Dolfor-Kerry Hills in the Welsh border area—the essential data of which are shown in Appendix II—showed that rough grazing areas could be improved to give a return of about 25 per cent to the farmer and about 5 per cent to the nation on the basis of the costs of improving the land only, spread over a period of from 6 to 9 years.

AREA OF MARGINAL LAND IMPROVABLE FOR AGRICULTURE

41. Various surveys have been made of the acreage of rough grazings and of marginal land; the results are summarized in Table III. According to the 1949 survey by the Agricultural Research Council and the Ministry of Agriculture, there were 2½ million acres of " upland livestock rearing land " in England and Wales the productivity of which could be improved. The comparable figure for Scotland may be about three quarters of a million acres (See Table III, Item C).

TABLE III

Acreage of Marginal Land in Great Britain(1)

			Million Acres
(A) *Mountain and Heath*			
Scotland	Mountain and heath used for grazing (includes 1·4 million acres deer forest used for grazing)		10·7
(B) *Hill Sheep Farming Land*			
(i) Scotland	Genuine hill sheep farming country (of which 0·15 million acres is in crops and grass) (stocking—1 breeding ewe to 4 acres)	6·2	
(ii) England and Wales	Hill and upland rough grazings (stocking—1 breeding ewe to 2½ acres)	5·0	
Total Hill Sheep Farming Land in Great Britain			11·2

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(1) Based on " Marginal Land in Britain " by Professor W. Ellison.

TABLE III (cont'd)

		Million Acres
(C) *Upland Livestock Rearing Land (includes enclosed land)*		
(i) Scotland ... (of which 750 000 acres improvable)	2·0	
(ii) England and Wales (of which all is improvable)	2·5	
Total acreage of upland livestock rearing land in Great Britain (approx.) (of which 3¼ million acres could be improved)		4·5
(D) *Low Lying Marginal Land*		
(i) Poor quality heavy land (of which 0·25 million acres are still improvable)	0·8	
(ii) Poor quality light land ... (of which 0·25 million acres are still improvable)	0·8	
(iii) Marshes ... (of which all is improvable)	0·1	
(iv) Small parcels of marginal land on medium and good land forms (of which 0·20 million acres are still improvable)	0·25	
Total low lying marginal land in Great Britain... (of which upwards of 800 000 acres are still improvable)		1·95

(E) Total marginal land in Great Britain which could be improved is about 4·1 million acres (of which upland livestock rearing acres are 3¼ million acres and other marginal land 0·85 million acres).

NATIONAL BENEFIT OF MARGINAL LAND AGRICULTURE

42. We have noted in paragraphs 39 and 40 above what return on capital could be expected to accrue from investment in the rehabilitation of marginal farm land. The same money put into lowland farms might result in a far greater immediate output of food and cash return on capital invested. The argument of immediate financial returns, based on averages, is however only one part of the story. It is essential that investment in farming on marginal land should be considered in relation to the overall role which these areas play or should play in our national life. Though they cannot supply food direct to distant markets, our hill and upland livestock rearing farms constitute an important breeding reservoir for the livestock farms of the lowlands. As it is, lowland farmers usually find it more economical to buy-in "stores", reserving their better pastures for fattening. The purchase of upland store cattle and sheep enables these animals, when transferred to lowland grazing, to make efficient use of the flush of grass in summer and to consume crop residues in winter. At the same time, the pastures of the uplands can be used to rear the surplus calves of the lowland dairy farmers as stores for beef production or as dairy replacements.

43. In this way, it can be argued, the integration of upland breeding and rearing with lowland dairy and fattening enterprises tends to the optimum use of pasture and arable crop areas. We appreciate that there is the contrary argument, that an equivalent or greater output could be obtained from the same investment restricted to the lowlands; that the traditional integration of lowland and upland farming is out-of-date; and that to continue to encourage such integration by differential subsidies in favour of marginal hill land is to ignore the economic " writing on the wall ". But there are major flaws in this argument. Firstly, we consider that to create in the lowlands a breeding and store-raising enterprise to take the place of the uplands would posit a degree

of mobility in livestock farming well in excess of what is practicable. In fact no one has ever suggested means by which the sheep industry could survive without the hill breeding grounds. Secondly, we consider that the implied subsidy discrimination in favour of marginal hill land is an illusion. Hill farms depend on direct subsidy to a remarkably small extent. The total of the subsidies specific to marginal hill land is trivial in relation to the cost of price guarantees⑴, from which these lands are excluded by virtue of their product. Thirdly, we regard the economic "writing on the wall" less as a general condemnation of upland agriculture than as a reflection of the present pattern of tenure and management in those areas. In practice, many farms on marginal hill land are highly profitable. These are the farms which include, in a comparatively large total area, a sufficient proportion of winter keep, and which are managed with skill. But the majority of these farms are too small and too exclusively tied to summer grazing. The consequence is the poverty by which these hill areas are characterized. And the consequence of poverty is a lack of amenities which in turn discourages the younger people with initiative from staying.

44. The nation thus faces the risk of losing the production of these areas, instead of gaining the additional production of which they are capable. In terms of quantities, it has been calculated⑵ that if 3¼ million acres of upland marginal land in the United Kingdom were improved so that the equivalent of 39 instead of 25 mature beasts could be carried per 100 acres, the national output of 1½ to 2 year old store cattle would be increased by about 400 000. These cattle when fattened on lowland farms would produce from 100 000 to 130 000 tons of carcase beef or about one-third of our imports of beef at the present level.⑶ This would represent a considerable contribution to the national economy.

SOCIAL ASPECTS

45. The general depopulation of outlying and remote areas is another issue, but it cannot be divorced from the discussion of the agricultural use of marginal land. The problem does not, of course, exist in isolation. It is merely the extreme of a social trend that has been associated over generations with the growth of industry; with the increasing productivity of agriculture in the more accessible lowland areas; and with an increase in the standard of living as measured in terms of an urban civilization. Factors such as the closing of village schools, and national service, are making the younger people of the marginal areas more familiar with the towns; and as the relative attractiveness of urban life increases, the drift from the land is bound to accelerate. Obviously, the few who hang on to upland and hill farms in marginal areas can look forward to the enjoyment of very few of the amenities of modern life. On the other hand the social consequences of any further abandonment of the already less populous and more remote areas of Great Britain occasion much disquiet, and have been the subject of numerous enquiries. From the strategic viewpoint the increasing concentration of population—as well as of production—in large urban centres is unwelcome. The accepted policy is to try to reverse—not to accelerate—those economic trends in upland areas which lead to depopulation. What we would stress at this stage is that if this general social policy is to be

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⑴ Such as those for arable crops.

⑵ "Marginal Land in Britain" by Professor W. Ellison. (See Table III item "D").

⑶ Around 350 000 tons of carcase beef were imported in 1955.

successfully implemented at a tolerable cost, some means of development must be found which, without detracting from the existing or potential agricultural contribution, will not depend for its development exclusively on agriculture.

CONCLUSIONS ON PRESENT PROSPECTS OF AGRICULTURAL DEVELOPMENT ON MARGINAL LAND

46. Our conclusions up to this point are therefore:—

(i) There are several million acres of upland marginal land in Great Britain capable of improvement.

(ii) As a breeding and rearing reservoir for cattle and sheep these areas are at present playing an important part in the production of meat, and could play a still more important part: hill farms are absolutely essential to the maintenance of the sheep industry.

(iii) The depopulation of these marginal areas is a source of increasing anxiety.

(iv) But production and population can only be maintained by capital development, and it is evident that development of agricultural capital is not, by itself, sufficient to correct the position.

PROBLEM OF FORESTRY IN GREAT BRITAIN

EXISTING FOREST RESOURCES COMPARED WITH OTHER COUNTRIES

47. Although our woodlands are the only major source of home produced cellulose materials, the proportion of land under forest in the United Kingdom is very much lower than in most other European countries (see Table IV). It is even less than that of Belgium and the Netherlands, where the density of population exceeds our own. The area of land classified as " forest " in the United Kingdom in fact amounts to only 3·9 million acres, or 6½ per cent of our land surface, and even so this acreage includes scrub and devastated woods which are totally unproductive. The percentage of productive forest is therefore very much lower.

TABLE IV

Forest Area in European Countries

	Total(1) Area ('000 acres)	Land(1) Area ('000 acres)	Forests(1) and Woodlands ('000 acres)	Percentage of Total Area under Forest
BELGIUM	7 500	7 500	1 480	19·7
DENMARK	10 600	10 400	1 080	10·4
FINLAND	83 200	75 400	53 500	71·0
FRANCE	136 200	136 100	28 200	20·7
W. GERMANY... ...	60 400	59 100	16 600	28·1
ITALY	74 300	72 400	14 000	19·3
NETHERLANDS ...	8 600	8 100	620	7·7
NORWAY	80 000	76 200	18 500	24·3
POLAND	77 000	76 900	18 500	24·1
SPAIN	124 000	123 100	31 000	25·2
SWEDEN	111 000	101 400	56 800	56·1
UNITED KINGDOM ...	60 000	59 500	3 900	6·6(2)

(1) Source F.A.O. Yearbook of Forest Products Statistics 1955.

(2) This figure represents closely that for Great Britain alone as the forest area of Northern Ireland, comprising 64 000 acres only, makes a negligible contribution to the United Kingdom total.

48. The acreages of woodlands in private and State ownership shown in Tables V and VI are based on the complete census of woodlands of 5 acres and over, taken between 1947 and 1949, and on the census of small woods and hedgerow timber taken in 1950/51.

TOTAL FOREST AREA AND HIGH FOREST

49. Table V shows the classification of all woodlands in Britain, both private and State, as determined by the former census.

TABLE V[1]

Classification of Woodlands by Type and Ownership Great Britain—1947

	All	Scrub, devastated or felled[1] ('000 acres)	Coppice[1] ('000 acres)	Small Woods under 5 acres[2] ('000 acres)	High Forest[1] ('000 acres)
Private	3003	1231	340	178	1254
State	624	78	10	1	535
Total	3627	1309	350	179	1789

[1] Census of Woodlands 1947-49.
[2] Census of Hedgerow and Park Timber and Woods under 5 acres 1951.

These figures cannot yet be brought up to date in a satisfactory way. It is known that by September 1955 many changes had taken or were taking place, e.g.:—

Since 1947 the Forestry Commission had acquired 222 000 acres of private woodlands of which some 28 000 acres were high forest.

The Forestry Commission had also increased their own area under forest to 1 005 000 acres (including the 28 000 acres referred to above).

It was estimated that in private woodlands some 128 000 acres had been planted or replanted between October 1947 and September 1955.

As at that date the total area of high forest must, therefore, have been less than 2 359 000 acres, since against the planting in private woodlands must be set off losses from fellings and destruction by fire.

POTENTIALLY PRODUCTIVE FOREST AREA

50. Not all the areas shown in Table V are considered suitable for economic management. Table VI sets out the position at September 1955 as far as it is known. But while this area is regarded as *potentially* productive it must be remembered that 1·3 million acres were classified in the 1947 census as scrub, devastated or felled. Thus probably one third of our potentially productive woodland is actually unproductive and, as we saw in the previous paragraph, the area of high forest is only some 2·4 million acres out of a total of over

56 million acres. Little more than a third of privately owned woodland is at present classified as "productive."

TABLE VI

Potential High Forest Area Great Britain—1955

		Thousand Acres
(A) *Private Woodlands—Suitable for economic management*		
(i) Large Woods⁽¹⁾	2208	
(ii) Small Woods⁽¹⁾	89	
(iii) Total	2297	
Less:—		
(iv) Private woodlands acquired by Forestry Commission, since the Census up to 30th September, 1955	222	
Private woodlands at 30th September, 1955		2075
(B) *Forestry Commission Forests*, Woods and areas awaiting planting at 30th September, 1955		1318
(C) *Total* Forest or potential Forest at 30th September, 1955		3393 ⁽²⁾

⁽¹⁾ The relevant census figures and their classification have been modified somewhat in the light of more recent information.

⁽²⁾ Hedgerow and farm timber, the product of which is equivalent to some 300 000-400 000 acres of forest, is not included here.

SUITABILITY OF GREAT BRITAIN FOR FORESTRY

51. The extreme neglect of forestry which is implied by these figures is the more surprising since trees are in no way an alien crop to Britain. After the last Ice Age, some 12 000 years ago, the British Isles were colonized by birch scrub, followed by birch/pine forest, with dense hazel undergrowth at the later stages. Even the Hebrides and Shetlands were under forest. During the Sub-Boreal Period (4000–500 B.C.) hardwood species such as oak and elm appeared in Scotland and in some places trees were growing at the 3200 ft level. Within historical times, large areas of our land were covered with trees. It has been estimated that at the beginning of the Christian era at least half of Scotland was covered by trees.

52. Large areas of the hill country of Great Britain were tree-covered even as late as the early Middle Ages. Since then there has been a continuous process of deforestation. Trees were felled to provide domestic firewood, and charcoal for the early iron industry, as well as for shipbuilding and other structural purposes. Woodlands were cleared so as to extend the arable farm area, and later to convert hill land into sheep runs. As indicated in paragraph 27, this last process has in many areas overrun its course. There seems no technical, as opposed to economic, reason why the process of decay should not, however, be reversed. Where areas have become marginal or sub-marginal for agricultural purposes, tree cover might be restored. On some of the higher ground, loss of fertility, leaching, and often also water-logging has gone so far that it is no longer practicable to get back to the production of timber trees immediately. It would almost certainly be necessary to pass through an intermediate stage of planting pioneer, non-economic stands of hardy trees to restore some sort of tree cover. One of the main advantages of such a step would be the improvement of soil fertility. Trees "imbibe" the nutrients of the subsoil through their roots, and the nutrients are then returned to, and regenerate the surface layer of

the earth in the form of dead leaves. Even in the short run, however, such plantations would have some value, for example, as shelter for livestock. Instances are known of double cycles of land use as between forestry and agriculture. In Lincolnshire, for instance, there are several places where the original forest having been cleared and agricultural crops grown, the land was abandoned and later planted with trees; now the trees have been cleared once more and again the land is being cultivated.

53. Our climate and soil are more favourable to the growth of timber than are the conditions which prevail in several European countries with a far larger cover of forest. Comparable figures for the rate of growth of timber are difficult to obtain. Nevertheless the following figures, which relate to productive forest⁽¹⁾, are highly significant:—

TABLE VII

Mean annual growth on a 70-year rotation

*(Hoppus feet over bark)**

	Scots pine	*Norway spruce*
Sweden	68	76
Germany	92	85
United Kingdom	151	147

* Hoppus foot = 1·273 cubic feet.

A much quoted statistic is that the annual rate of growth of trees which can be obtained, by proper management, in Great Britain is nearly twice that of Germany and Eastern Europe, and almost four times that of Finland. We draw attention to this point not as a conclusive argument in favour of greater afforestation, but to demonstrate that there is nothing unnatural in the idea of a much greater forest programme for Great Britain.

CURRENT DEVELOPMENTS IN FORESTRY

54. Since many years must elapse before a new forest can be brought to the stage at which a regular annual yield of mature timber can be obtained, the 1943 plans (referred to in paragraph 16 *et seq*) for the establishment of a state forest envisaged a high rate of planting during the early decades, tapering off towards the end of a 50-year period. It has, however, proved impossible to implement the programme. Although the annual rate of planting was increased from 26 000 acres in 1947 to 70 000 acres in 1954, this was done only by materially reducing the reserve of land awaiting planting. In 1947 this reserve was nearly fourteen times the area planted; the figure for 1955 will be less than five times, and the reserve is very unevenly distributed. In the words of the Forestry Commissioners in their 35th Annual Report " the point has been reached where the Commissioners have been forced to accept the unpalatable fact that after 1954 the annual planting programme will not only stop increasing, but will in fact fall." The fact is far more than unpalatable. From the national point of view it implies more rural depopulation; and greater reliance on imports, and by that token, more pressure on our export industries. All this seems paradoxical in view of the vast extent of our marginal hill lands.

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(1) It scarcely needs to be said that the actual average rate of growth obtained now in Great Britain—taking into account the large proportion of our woodland which is classified as " scrub, devastated, or felled "—is much below the potential figure: it is in fact below the averages achieved by countries where natural conditions are less propitious.

55. An expanding planting programme cannot be maintained without adequate reserves and a suitable intake of plantable land. In the following paragraphs we examine what land resources are potentially available for forestry.

MARGINAL LAND IMPROVABLE FOR FORESTRY

56. Trees, like agricultural products, do better on good than on bad soil, and the balance between the two, so far as land use is concerned, can only be decided by a combination of immediate financial considerations and general political and social policy. Regardless of any possible financial advantage, the dictates of the latter would see to it that in general any expansion of our forest acreage must be confined to marginal areas. In the Acland Report (referred to in paragraph 13) it was estimated that there were not less than 3 million and probably not more than 5 million acres then (1918) utilized for rough grazing which would have been capable of growing first-class coniferous timber. These remarks were still regarded as " pertinent " in the Forestry Commissioners' 1943 Report. The Commissioners looked to the 16 million acres of rough grazing (Table II, page 10) for the three million acres⁽¹⁾ of bare land which they proposed should be planted with trees (see proposals quoted in paragraph 16). Although at that time no comprehensive survey of suitable land for forestry had been completed, it was computed from a series of incomplete surveys of the country's woodlands that the acreage of rough grazings, mostly upland and hill land, suitable for afforestation was 4·2 million acres, of which approximately half was in England and Wales, and half in Scotland. Without a detailed survey, it is impossible to say how much of this land is also included in the area improvable for agriculture (see para. 41).

AFFORESTATION ELSEWHERE THAN IN MARGINAL AREAS

57. Most of the land needed to increase the area of productive forest will have to come from the present area of privately owned rough grazings. But there are other possibilities, which in our view should be more fully exploited, of adding to the productive forest area. These include:—

Coppice etc.

58. " Coppice " may be defined as small areas of (broad-leaved) woodlands which are cut periodically for use or sale before the trees grow into large timber. The total area of coppice, including " coppice with standards ", broad-leaved scrub, and devastated woodlands in Great Britain, is not far short of a million acres. The greatest concentration is in South-East England, where there are 350 000 acres, mostly in private ownership. The demand for small-sized broad-leaved timber, grown in the form of coppice, has declined over the centuries, and there is at present little use for this form of timber. A little of the coppice area is now worked on a regular rotation, but the current annual demand is less than one-third of the annual production. There is consequently a surplus accumulation of many years' growth. The main use of this surplus coppice area is for the protection of game. While it may provide profits through the letting of shooting rights, this is scarcely an adequate contribution to our

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⁽¹⁾ The area of bare land still required (by the end of the century) for the implementation of the 1943 plans has been reduced by the area since planted up or acquired for planting, and also, to an extent which cannot be precisely determined, by a reassessment of the area of old woodland which can be made productive. If allowance is made for these factors the amount of bare land still required for planting may lie between a million and three quarters and two million acres.

national income. Most of the surplus coppice is, by forestry standards, on very good land, capable of bearing high forest. Conversion to high forest is however an expensive operation, in most cases beyond the means of the present owners.

Water Gathering Grounds

59. Some half a million acres of land are used as water gathering grounds by various water undertakings. Agriculture is allowed to proceed on 200 000 acres, but under conditions which restrict, to a greater or lesser extent, its full use—the reason usually being the necessity to prevent water pollution. Only 17 000 acres are at present afforested, but a further 15 000 acres have been leased to the Forestry Commission by Local Authorities during the past four years.

60. Water supplies must be kept free from pathogenic organisms coming from the human body. The only reliable indicator that human sewage is reaching water is the presence of a micro-organism, the *Bacillus coli.* This organism is also found in the excreta of animals, and if cattle grazed unrestrictedly on gathering grounds, the detection by bacteriological analysis of *B. coli* in the reservoir would not necessarily reveal the presence of pollution from humans. What is otherwise a most valuable pointer to pollution would thus be nullified. These considerations represent the principal reason for restrictions on the agricultural use of gathering grounds, especially where little purification or treatment is available for supplies. The use of artificial fertilizers on gathering grounds is sometimes objected to on the score that, where they are washed into reservoirs, they foster the growth of algae which cause mechanical difficulties in filters.

61. Where authorities are unable or unwilling to undertake full purification treatment of their water, it would appear that (except in regions of low annual rainfall) this land would be better utilized if it were afforested. The Departmental Committee on British Forestry, reporting in 1902, drew attention to the technical and other advantages the water authorities would derive from planting their catchment areas with trees. More recently the Ministry of Health's Report on Gathering Grounds (1948) recommended that, (subject to reasonable safeguards) gathering grounds should be put to the utmost agricultural use or afforested. The qualitative problems of effects of agriculture and forestry on water supply have been much discussed, but (as indicated in paragraph 28) little attention has hitherto been directed to the quantitative aspects, e.g. how different methods of land use and land management in this country affect the absolute amount or the seasonal pattern of stream flow and of ground water recharge. Further research on these topics is urgently needed. Subject to confirmation that the amount of water supply will not be unduly affected, it appears that there is still considerable scope for using water gathering grounds for forestry, if not for agriculture.

Commons

62. The acreage of land subject to rights of Common in England and Wales is not accurately known. It is thought to be between 1½ and 2 million acres, i.e. approximately 5 per cent of the total area of England and Wales.

63. The country's present attitude towards commons, and particularly the neglect of their full productive use, is a legacy of the change in opinion that occurred in the nineteenth century. When corn was dear and population

rapidly increasing, the inclosure of land, by which was meant the extinguishing of rights of common and the allotment of the land between the owners of the soil and the commoners, was regarded as an advance in land use which would lead to the adoption of better agricultural techniques and to the more productive use of the land. This movement continued apace in the latter part of the eighteenth century, when legislation had encouraged inclosure by simplifying the process and lowering the cost, and into the early nineteenth century. Later in the nineteenth century, as imports of corn became cheaper and more plentiful, there was a reversal of policy. Legislation was passed hindering inclosure, and introducing in its place the regulation of commons, with the object of preserving them as open spaces for the recreation of the local communities including the population of neighbouring cities. The legal rights of the commoners were, however, in no way affected, and the owners of the soil were left in possession. The conservators of "regulated" commons were given powers to improve them by draining, levelling and manuring, and by planting trees on parts of the common, or by employing any other means which would improve or add to their beauty. However the law was so drafted as to put great difficulties in the way of economic development (including afforestation) of common land.

64. Even if they had the means to manage them so as to make any great contribution to the nation's wealth, many of the owners of "commons", and the conservators of our "regulated commons" are thus virtually unable to do so because of the law. In some cases it is as much as they can do to safeguard commons as places of recreation, and to carry out necessary works of maintenance. The problems of common land are now being considered by a Royal Commission. We would merely say that there seems considerable scope for the increased planting of trees, which could hardly fail to do good: throughout the country thousands of acres might be added to our forest area without in any way restricting access by the public or injuring amenities.

Hedgerow and Park Timber.

65. Timber in hedgerows and small plantations accounts for one-fifth of our total standing reserve, (Census Report No. 2 Forestry Commission, 1951) and if the timber in small woods of under five acres is included, the proportion is over one-quarter. Moreover, as hedgerow trees consist almost wholly of broad-leaved species, they account for one-third of our standing reserves of hardwood. Due to the care and foresight of earlier generations there are many timber trees nearing maturity both in hedges and in open fields. A Committee under Lord Merthyr, which has recently reported(1) on the question of hedgerow and farm timber, reached the view that (particularly in England and Wales) there is a danger that the number of young trees in hedgerows and parks is insufficient to replace those which are now coming to maturity. The Committee considered that room could and should be found for more trees on farms as well as on industrial and other land.

General

66. We have set out at some length the possibilities of increasing timber production by improving the management of coppices, small plantations and hedgerows, and by afforestation on water gathering grounds and commons. Although many of the areas available are individually small, the total area concerned is substantial. Moreover, a good deal of the total is relatively good and accessible land, which is particularly important as a source of hardwoods.

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(1) Report of the Committee on Hedgerow and Farm Timber 1955. H.M.S.O.

Conversely, at the moment the management of timber in coppice, park land, and hedgerows is probably deteriorating rather than improving.

67. We recognize that the cost of managing even small areas of timber is often beyond the resources of the private landowner, particularly as it requires workers with special skills for whom many private landowners would not have full-time employment. This difficulty may be overcome in some districts by private forestry contractors or co-operatives. We are glad to note that the Forestry Commission are encouraging the development of co-operative forest societies by secondment of staff as well as by financial means; that so far as possible they have met requests by private landowners for loan of labour and equipment: and that a substantial number of quite small areas have recently been included among the properties acquired on their behalf. We consider that further development on these lines should be encouraged. In particular we think there is scope for an increase in the technical-advice service on forestry, and for more information about the economics of managing a number of small blocks of existing woodland from a common centre by means of mobile squads of foresters. Development along these lines might well awaken a new interest in timber production, and would help especially with the problem of hardwood supplies, for which suitably fertile land cannot generally be spared.

68. Important as these possibilities are in their own right, their realization would inevitably be slow, and even so they only touch the fringe of the problem of the national forest programme. For a reasonably steady development of home timber supplies we are still bound to look to the marginal hill areas.

POTENTIAL FOREST PRODUCTION

69. The main points that have emerged so far from our examination of the facts about domestic timber production are:—

(i) Physical conditions in Great Britain are more favourable to the rate of growth of trees than are those of many European forest areas.

(ii) Even when we include all stands of timber, including hedgerows, trees nevertheless cover less than 7 per cent of our total land surface, and relatively less than that of any major European country.

(iii) A third of our existing woodland is unproductive and in need of rehabilitation.

(iv) We have a very large area of rough grazing land, of which a good deal is not now well used, while some 4 million acres is believed to be potentially afforestable.

(v) Nevertheless our forest planting is being held back for lack of land.

(vi) Much of the land which could be planted is on livestock hill-farms which are a traditional complement to livestock fattening on lowland farms. But many of these farms are economically marginal and in many cases the fertility of the land is not merely low but declining.

70. Three central issues need to be examined before we consider the rehabilitation and development of marginal land by afforestation:—

(i) the financial and import-saving returns of forestry compared with those of agriculture on marginal land;

(ii) the nature of the obstacles which now prevent the acquisition of marginal land for forestry;

(iii) the competition between forestry and agriculture for marginal land.

RETURNS FROM AGRICULTURE AND FORESTRY ON MARGINAL LAND

FINANCIAL RETURNS

71. Although the production processes of forestry and farming are fundamentally similar, there is such a great difference between the lengths of their respective production cycles that a comparison of net returns is not a simple matter. In Great Britain the problem is the more difficult because, while agriculture has for centuries been practised on business lines in all parts of the country, the same is not true of forestry. The likely physical returns of both can be estimated fairly accurately if reasonable standards of management and average yields are assumed on both sides. However, the translation of the physical returns into financial returns introduces a large element of conjecture. The projection must cover a full cycle of forest production, i.e., a matter of half a century or more. Clearly, over such a long period it is to be expected that there will be substantial changes in all price levels. In addition, the prices of both timber and agricultural products are liable to considerable short-term fluctuations. Elsewhere in this Report we have suggested that there are reasons to suppose that the prices of food and other primary organic materials may rise relative to the general price trend (paragraph 31). But there are no precise indications to future relationships between food and timber prices.

72. These difficulties have to be accepted in an analysis of the future role of afforestation in the marginal land areas. Since we considered that a financial assessment was essential for the purposes of this Report we set up a Working Party, which was helped by a number of distinguished experts, for the express purpose of examining the economic aspects of the transfer of land from agriculture to forestry and vice versa. The Working Party decided that the best means of arriving at an assessment was by examining the costs and yields (so far as data were available) of actual examples of forestry and agriculture enterprises which were being carried on side by side.

73. Before describing the conclusions that were reached, we wish to emphasize that they are put forward with considerable reserve. In the circumstances of this Report it is necessary to infer general conclusions from presumably typical cases. The conclusions should not however be re-applied to other specific cases without careful preliminary examination.

74. The areas chosen by the Working Party for examination were the New Forest and the Sherwood Forest, as examples of poor light land, and Netherwitton in Northumberland, and Kerry in Montgomery as illustrating the marginal and the better hill lands. An outline of the method of calculation used is given in Appendix III. It transpired that if farm buildings had to be provided there was little to choose in the New Forest between forestry and agriculture. Improvement of land already in agriculture and requiring no buildings held more promise for continued agricultural use than if it was transferred to forestry (5·9 per cent interest for forestry; for agriculture the interest was 19 per cent if no buildings needed, and 5·4 per cent if farm buildings were required). In the Sherwood Forest the comparison showed that the return from agriculture

(6·5 per cent) was about as good as that from forestry (6·7 per cent). An integrated programme of farm improvements, combined with forest planting, was considered to be most satisfactory for this area. On the marginal upland areas that were surveyed, forestry tended to have a slight advantage with a return of 6 to 8 per cent on the invested capital, whereas on land under agriculture the total return on the landlord's and tenant's capital was from 6 to 7 per cent. This is in fair agreement with the survey of hill and livestock rearing farms in 1953/54.⁽¹⁾

IMPORT SAVINGS

75. The assessment of future import savings is more difficult than that of financial returns, and can only be discussed in the broadest terms. Increased production from either forestry or pastoral agriculture will clearly result in a saving of imports, but the proceeds from agriculture are relatively immediate compared to those from newly planted forest. Capital development in agriculture achieves its maximum rate of return within two or three years, whereas in forestry it does so only in, say, fifty to sixty years. But even after making allowances for such considerations, we have formed the view that in the long-term afforestation of marginal land would yield greater import savings than would agricultural development—assuming that these were mutually exclusive methods of use. The balance in favour of forestry might be substantial, and we think it probable that future generations would reap larger direct returns if much of our marginal hill land were afforested than if it were all retained in agriculture.

PROSPECTS IN THIS GENERATION

76. On the other hand, while the prospect of returns on existing well managed forest is fair, and the long-term prospect of new afforestation is good, the immediate prospect of direct return from new afforestation is by no means so clear. In the following sections we have therefore tried to assess the situation with respect to supply and demand for timber and forest products in greater detail.

REQUIREMENTS AND SUPPLIES OF TIMBER AND CELLULOSE MATERIALS AND THE SCOPE FOR DEVELOPMENT OF UNITED KINGDOM RESOURCES

77. In the short-term the obvious considerations which govern developments in forestry are the immediate financial returns, and these depend on the demand for four related groups of commodities. Their order of magnitude in our import list in 1955 was:—

	£ millions
Saw-logs and sawn timber, including timber for: building construction and joinery, box and crate industry, railway purposes, furniture industry, agricultural purposes	179
Mining timber; including both round and sawn	10
Pulp-wood, including wood for manufacture of hardboard, insulation board and chipboard as well as for paper	3
Pulp for paper	87
Pulp for textiles, fibres and for films	19

⁽¹⁾ Progress of Improvement on Upland and Hill Farms in England and Wales. *J.R. Agric. Soc.* **116,** 34.

Less important items, together with finished products (including paper, plywood, textiles, furniture) based on the same materials bring the total up to £430 millions. Together they make up about 11 per cent of the total import bill.

SAW TIMBER

78. The demand for timber (both hardwood and softwood) as sawn logs and planed or dressed timber is considerable. The value of our imports in 1955 was about £180 millions. In the same year home production (based on average import values) amounted to only about £17 millions. If and when the Forestry Commission's target of 5 million acres of mature and productive forest is achieved, its annual sustained yield will not meet more than about one-third of even our present requirements. In view of the rising trend of consumption it seems likely that the Commission's present planting programme could be trebled, providing that costs were competitive, before there was any likelihood that sawn timber from home resources would exceed domestic requirements in general.

SOFTWOOD

79. Since 1950 home production of softwood saw timber has amounted to about 5 per cent, by volume, of consumption. In 1955, for example, it was some 50 thousand standards (1) compared with imports of some 1720 thousand standards (1). By 1980 home production is still likely to be less than 13 per cent of present consumption, even though most of our forestry programme (including re-afforestation of areas in which hardwoods have been felled) is for the planting of conifers. These have been favoured on the grounds that they produce the type of wood most needed in an emergency, whether military or economic. In general they are also less costly to cultivate, mature earlier and give greater yields per acre.

HARDWOOD

80. Imports of non-coniferous wood (hewn or sawn) in 1955 cost about £31 millions sterling. Although home production, in terms of quantity, has been running at nearly 40 per cent of consumption, the present indications are that hardwood production will not be increased after 1960, and thereafter will probably approximate to the pre-war rate (i.e. around 20 per cent of consumption). Most of our hardwood forests were planted during the Napoleonic Wars (with the deliberate object, in some instances, of producing bent timbers for ship building). Since 1918 the planting of hardwoods, whether by the Forestry Commission or by private landowners, has been on a relatively small scale, though it is now increasing. Apart from the forests, a large proportion of our existing hardwood trees are in hedgerows, or in small plantations where it is now more or less a matter of accident whether they survive to maturity.

81. In order to conserve our resources of timber after the heavy fellings of the war years, a limit has been fixed for the amount that may be felled in any one year. In 1954/55 actual fellings of hardwood were below the permitted limit.

82. By modern standards of sylviculture the pre-war hardwood forests (even those which had been properly planted) were seldom well managed—and this, of course, applies with even greater force to hedgerow and other "accidental" hardwood resources. Consequently the timber they produce suffers from numerous faults (outlined in great detail in the Second Report of the Royal Commission on Coast Erosion and Afforestation (Cmd. 4460)

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(1) Standards of 165 cubic feet.

in 1909). Not surprisingly, the quality and consistency of our homegrown hardwoods usually compares unfavourably with that of imports.

83. While certain species of imported hardwood, such as teak and mahogany, cannot be grown here, it is notable that we import, mainly for the furniture industry, sawn oak and beech to the value of £4 millions and £6 millions respectively. These are the very hardwoods which are most characteristic of the woodlands of (southern) Britain, beech on the thin soils of our chalklands and oak on the clay. While home grown timber cannot be substituted in all uses for imported material, there is clearly scope here for savings of imports. As we have noted above, the Forestry Commission are in certain areas pursuing an active policy of hardwood improvement. Outmoded methods of hardwood management (such as the "coppice-with-standards" systems) are being replaced by new techniques such as the "group regeneration" system, by which groups of young trees are planted in the shelter of existing standards. By this means the Forestry Commission hopes to develop vigorous hardwood stands of varying ages and often with varying species in the same wood. The Commission is interested in improving the quality of hardwoods supplied for home requirements, including specialized markets such as that for bobbins for the textile industry.

UTILIZATION OF THINNINGS

General

84. Even with the adoption of modern sylvicultural techniques it takes many years before a newly planted forest reaches the stage when it will give a sustained yield of timber. During the interval most of the output takes the form of thinnings and other small sized material, much of which is too small for the sawmill. The greater part of the Forestry Commission's plantations to date are still at this stage, and obviously the output from any further plantations would for a considerable period take the same form. Even when a forest reaches maturity, i.e. the sustained yield stage, from one-third to one-half of its output consists of thinnings. The uses of thinnings include firewood, pit props, box-making and material for fibre building board and chipboard or for pulp. On the Continent the use of thinnings as firewood accounts for upwards of 40 per cent of the total round-wood production. Since coal is our usual domestic fuel, this outlet is extremely small in Great Britain (though here there may be some scope for expansion). The other possibilities are more important and they are therefore examined separately below.

Pit Props

85. There is a long established outlet for thinnings as pit props. British mines currently use around half a million standards(1) of round pit props and a quarter of a million standards of sawn mining timber. Something over half of these requirements are met by imports, the cost of which amounted, in 1954, to some £10 millions. By 1980 it is estimated that the domestic output of softwood thinnings will amount to no more than the equivalent of half a million standards of pit props(1). Even though the demand for pit props is gradually declining (owing to more economical use of timber, and to the introduction of metal props) it would therefore seem that our mines should provide an outlet for a substantial proportion of home produced thinnings.

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(1) Gothenburg standards i.e. 180 piled cubic feet or approximately 100 solid cubic feet (hoppus measure).

86. On the other hand the needs of the mines do not correspond precisely with the output of the various sizes of thinnings from the forests. The mines want few pit props of large diameter or of less than 2½-in. diameter whereas the first and even the second thinnings of a new forest include a high proportion of smaller sizes. Moreover the price which the Coal Board pays for home produced material depends on the price at which imported props can be bought; and home supplies from remote inland areas have to bear heavy transport costs.

87. Thus under normal peace-time conditions the mines could not be the sole outlet for home produced thinnings. While there is room in some forest areas near the mines for production additional to that planned, in others, for instance in Scotland, our forests are already fulfilling nearly the whole requirements of the mines and the output of thinnings is still increasing. Forests remote from mining areas must also find other outlets for their total production of thinnings. The profitable disposal of softwood thinnings not required for the mines, and of all hardwood thinnings, must therefore depend on other end uses.

Fibre Building Boards

88. Building board (hardboard, laminated wall board, insulation board and chipboard)⁽¹⁾ are made from cellulosic materials, such as wood, bagasse (a waste product of the sugar cane) and waste paper; the wood may be derived from thinnings, lop and top, and other forest waste, and also from joiners' and carpenters' waste. These boards are used increasingly in house and other building, and are also popular with furniture manufacturers. They are bought in large standardized panels which require little finishing. They have the special advantage that they can be used to make hollow partition walls and ceilings without hand plastering.

89. The continuation of a high level of new building, with a renewed emphasis on slum clearance, as well as the need for increased thermal insulation of buildings in order to save fuel, points to a continued demand for this class of material. Consumption of fibre building board⁽²⁾ appears to be rising substantially. The figures in Table I indicate that 216 000 tons were available for consumption in 1955 (of which 50 000 tons home produced) compared with 108 000 tons in 1953 (of which 44 000 tons home produced). Even allowing for changes in stocks, this indicates a marked upward trend. The raw material used for the home output was equal to about 4 million cubic feet of timber, or between 10 and 20 per cent of our present yield of thinnings. The installation of additional capacity for fibre building board would provide a valuable outlet for the smaller sized thinnings from forests near the mines, while in remote areas the whole output of thinnings could be used for this purpose. A plant for the manufacture of chipboard, with a capacity of about 10 000 to 12 000 tons a year has been erected at Annan in Dumfries, and is in production.

90. Total capacity for the production of hardboard and insulation board will increase from 51 000 tons per annum in 1955 to 71 000 tons by the beginning of 1957, and a further extension is expected to take place by the end of 1957. The bulk of this extra capacity will be provided by the existing producers, but one new enterprise is expected to come into operation during that period. Other projects for extension have been temporarily postponed, mainly because

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(1) A brief explanation of technical terms used is given in Appendix VIII.

(2) Excluding chipboard, for which figures are not available.

the market for building board is becoming more competitive due to greatly increased imports from Sweden, following the liberalization of imports in December, 1954. Swedish competition is formidable in spite of the existence of a 20 per cent tariff, and it would therefore be unwise to assume that an unlimited expansion of building board production in the United Kingdom would be economically possible. It is nevertheless essential that caution should continue to be exercised in siting additional plants, especially in those areas where the forest output is likely to increase considerably, so that short-term advantage should not prejudice the future possibility of establishing pulping plants which have a far greater demand for timber.

Pulp for Paper and Man Made Fibres

91. After constructional and other sawn timber, wood pulp for the manufacture of paper and man-made fibres⁽¹⁾ constitutes the biggest call we make on cellulose products. Very little pulp is produced domestically and in 1955 imports cost us over £100 millions (see para. 77). Messrs. Wiggins Teape are establishing a hardwood pulping mill at Sudbrook (Monmouthshire), and the Bowater Paper Corporation are now building a groundwood pulping mill at Ellesmere Port. Both of these mills will be using domestic raw materials, although not exclusively.

92. At first sight there would seem to be room for considerable import savings in this field, and an outlet for a very large quantity of timber, including thinnings. In fact, numerous difficulties, ranging from siting problems to the hazards of a market characterized by sharp price fluctuations, discourage pulp production at home.

93. Since it is possible that alternative materials and sources of supply may also discourage the use of domestic timber for pulp, we have examined the possible contributions from waste paper, straw and similar commodities to our pulp supplies (see Appendix IV). The contribution which *waste paper* already makes to our economy is considerable, consumption in 1955 being equivalent to almost one-third of the fibrous materials used by the whole paper and board industry. There is no technical, as opposed to business, reason why more should not be used in this way, and it is possible that, if it were, the resultant import saving would be of the order of £4 to £5 millions. On the other hand it is doubtful whether substantially more import savings could be achieved by further substitution of waste paper for imported wood pulp. The main users of waste paper are the board makers. Many types of paper cannot be made from waste paper. Mixed waste produces a paper of inferior strength and colour to that made from wood pulp and one which might not find a ready market either here or overseas. Economic, as opposed to technical, factors therefore limit the substitution of waste paper for pulp. Moreover there is a danger that any reduction in Great Britain's output of better quality paper might lead to an increased import of this type of paper to meet demand.

94. Potentially, *cereal straw* is somewhat more important. Some 500 000 tons could, in theory, be made available annually for pulping. This would represent an import saving of over £8 millions. But there are considerable difficulties which prevent this amount being collected and sold: and straw pulp is hardly a substitute for wood pulp under normal trading conditions.

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(1) There are several grades of pulps used for paper making, as well as a distinct grade, known as "dissolving" pulp, used for rayon manufacture. A brief description of these grades is given in Appendix VIII.

95. We have already recorded the view that increased demand for forest products in all countries of the world, as well as increased costs of production, extraction and transport, are likely in the long term to force up the price of timber and pulp. This trend will affect countries inside as well as outside the Commonwealth or Sterling Area. We have made a special study of potential *supplies from the Commonwealth*, of which a summary is given in Appendix V. So far as we can see only Canada and South Africa are likely to have significant surpluses. Dollars have to be paid for Canadian supplies and we also have to complete with Canada's best customer, the United States. Here our ability to afford dollars is likely to continue to be a limiting factor. The position is very different in South Africa. There is no exportable surplus as yet, but United Kingdom interests are already financing forest developments in this part of the Commonwealth with a view to obtaining a new source for pulp. While it is difficult to assess the probable impact of these schemes on the total of available pulp supplies, it is possible that if they succeed, they may discourage interest in possible domestic developments.

96. However significant, therefore, the potential contribution to import savings of an extended use of waste paper and of straw pulp may be, neither of these raw materials would carry us far towards the satisfaction of our total requirements, and neither helps us much in assessing the role which our own woodlands should play. Again so far as Commonwealth sources are concerned, shortage of dollars constitutes a difficulty over Canadian supplies, while even possible South African supplies would have to be bought out of exports earnings, and these, even in the sterling area, need to be husbanded if our assessment of our future foreign trade position (paragraphs 29-32 above) is correct. Accordingly, no considerations of alternative sources of domestic or Commonwealth raw materials for pulp should, in our opinion, stand in the way of the use of domestic timber for the making of pulp.

97. There are, however, a number of real difficulties which do stand in the way. Although pulping processes vary, production always needs to be on a substantial scale if it is to be competitive. At the one extreme is the groundwood process in which an output of 10 000 tons per year may be economic; at the other extreme is high grade dissolving pulp for rayon, the manufacture of which is said to necessitate an annual output of 40 000 tons of pulp to be economic. Because of the great import saving value of man-made textiles, we have considered very closely the question of producing dissolving pulp in this country. Unfortunately it is extremely doubtful whether such a mill could be sufficiently well sited to be supplied with raw material from home sources at economic cost. Not only would a very large stand of timber be needed: it might also involve a special planting programme as spruce or (North American) hemlock are the most suitable woods for this purpose. Furthermore, ready access to a large forest area is only one requisite in siting a pulp mill. Equally important are availability of supplies of water, means of dealing with effluent; and good transport links with markets. All these difficulties apply to smaller pulp mills as well.

98. It is therefore very important that we should find out what is the smallest size of softwood pulp mill which is likely to prove economic. An investigation of small scale pulping plants has been proposed by the United Kingdom as a project to be undertaken by O.E.E.C's European Productivity Agency: it is hoped that the project will be approved shortly and that the investigation and report will follow quickly.

Home-grown Timber for Pulp

99. A wide variety of coniferous softwoods (and some hardwoods) can be used to produce sulphate (Kraft) pulp, from which strong wrapping paper and bags are made. Sufficient timber to supply a mill producing 15 000 tons of sulphate pulp per annum (say 30 000 cords or 2·25 millions cubic feet solid) could be found immediately in Northern Scotland, and within twenty years in Central Wales and in the Border country.

100. Erecting and equipping a mill demands considerable capital. There is an international market for wood pulp, and the price is very sensitive to supply and demand, while demand for papers and paper products very much depends on the general level of economic activity at home and abroad. The continued and relatively steady increase in the total production of the major industrial countries since 1950, coupled with the absence of any signs of over-production of pulp, have combined to improve the prospects of marketing home-produced pulp, provided that supplies of raw material could be obtained at prices which, in terms of the world price of pulp, manufacturers could afford to pay.

101. This is even more important than the technical problems to which we have referred. We suspect that a major factor which discourages manufacturers from committing themselves to projects which would convert home-produced timber, including thinnings, to products of high import saving value, such as pulp for paper, has been the discrepancy between the price they could afford, and the price at which they believe thinnings could be delivered to the mills—calculated according to conventional forest accounting methods. It is therefore urgent to consider the validity of these conventions.

102. Thinnings and mature timber are joint products. One cannot be grown without the other. When planting is under consideration it is reasonable and indeed necessary to allocate estimated costs and returns between them according to some conventional system. Once planting has been embarked upon, the allotment of a percentage of planting and maintenance costs to one or other of the joint products is only an arbitrary procedure of accounting. So long as the price that can be obtained for thinnings exceeds the cost of extraction, it will pay to extract. Indeed if one takes into account the value of the industries which use the thinnings, it may be in the national interest to extract, even at a lower price.

103. The production of thinnings is incidental to the Forestry Commission's main function of increasing the national reserves of standing timber. It would be unfortunate if estimates based on a conventional method of distributing costs between joint products were to appear to price the thinnings out of reach of pulp manufacturers, and hence to prevent the full exploitation of the resources which the Commission is providing. The point is not academic. Relatively small adjustments in the factors affecting the future costing of thinnings, associated with some assurance of constancy of supply, might well induce a large industrial user of pulp to install a pulp mill in this country. Some flexibility in attitude might well be justified in order to induce paper manufacturers to embark on the high capital expenditure involved in erecting pulp mills.

104. If the Survey referred to in paragraph 98 above holds out better economic prospects for the small scale production of wood pulp from indigenous materials in this country, we hope that the Forestry Commission and the other Government Departments concerned will encourage such a

development: for it would not only help to solve the problem of an outlet for thinnings from existing forests but also provide a great encouragement to the development of forestry on a really large scale by private individuals and public bodies.

105. In general, then, we may conclude that while there is an unending demand for such sound commercial saw timber as can be produced, an increasing volume of material below saw-log size is being produced for which the demand is more limited. New industries are developing to utilize some of this material, but further outlets are wanted, or will be required. Present ones are not sufficient to assure early returns which can go far in helping to cover the costs of planting and maintaining the new forests. If the conventions of forest accounting could be modified so as to decrease the element of costs to be borne by thinnings, and if small pulp mills of say 10 000 to 20 000 tons capacity were found to be economically possible, paper could be produced from home-grown thinnings. This could represent the most useful single development in the disposal of our forest products.(1)

PRESENT OBSTACLES TO AFFORESTATION

106. The lack of early financial advantage goes part of the way to explain the slow development of forest resources in Great Britain, despite the vast area of marginal land. This lack obviously affects private interests, and it also has a bearing on Forestry Commission operations. But it is by no means the whole story. In the following sections we examine other obstacles which at present stand in the way of the more rapid implementation of our National Forest Programme.

OBSTACLES TO AFFORESTATION BY PRIVATE INTERESTS

107. On a good many of the remaining large private estates there is a fair proportion of woodland. On the best-managed estates this woodland is kept in a productive state, and areas felled during the war are being restocked, often under the Forestry Commission's Dedication Scheme. But even with such assistance, there remain very few estates which can bear the costs of large-scale afforestation, as well, in some cases, as the restocking of scrub, devastated and felled woodland. All this involves a very large capital investment, which once committed cannot readily be withdrawn; a long period of waiting for returns; a fair degree of risk of fire and storm; and finally a market which (though attractive in the long term for mature timber) is liable to considerable short-term fluctuation. These adverse factors would have been less important financially had afforestation always been practised on a continuous basis, and if there was always large timber coming forward to cover the cost of regeneration. This is not generally the case, and the position has been made worse by the fellings made necessary during the wars and during the immediate post-war period, when timber prices were kept down by controls, and replacement planting became exceptionally difficult. Unquestionably, these financial difficulties are underlined by fears about possible future trends of taxation.

108. Moreover, forestry requires a certain degree of specialization even within an estate. The break up of large estates, and the increase of owner-

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(1) For a more extensive examination of some of these topics, reference may be made to the report of the Committee on Marketing of Woodland Produce (H.M.S.O., 1956) which was published while the present report was in the press.

occupancy of farms, have made it difficult for skilled forest workers to find a place in private enterprise, and such men are now all too rare. Forestry co-operatives and contractors may in the end take the place of the estate forestry department, but the fact remains that, while estate owners and their agents in previous generations frequently had a great personal interest in forestry, small landlords and owner-occupiers today are almost bound to concentrate their attention and financial resources on the day-to-day problems and the increasingly heavy capital requirements of farming. The Committee on Hedgerow and Farm Timber expressed the view that "with notable exceptions, many farmers and land owners are not well informed on the subject of trees, and tend to regard timber cultivation as alien to their proper activities."(1) This tendency is undoubtedly encouraged by a general institutional bias, the importance of agricultural development being emphasized by political and departmental activity, a vigorous farming press and powerful agricultural unions and societies.

109. The question of game preservation is perhaps a minor one, but it cannot be overlooked. Undoubtedly much of our existing private woodland was retained or specially planted with the idea of sport principally in mind: and the common equation of woodland with game preservation operates in several ways against afforestation. Many of those interested in game undoubtedly suspect that regeneration of woodlands is irrelevant, if not positively opposed to the enjoyment of sporting rights (although in fact it can be shown that the two can be reconciled quite satisfactorily). This tends to put a brake on private afforestation. Moreover, as we shall note later, it makes acquisition on behalf of the Forestry Commission more difficult. On the other hand, those who see the preservation of all wild game as, in one way or another, a drag upon agricultural output tend to regard all woodland as obnoxious.

110. These factors help to explain the failure to regenerate speedily the large area of existing unproductive woodland in private hands, as well as the lack of new private afforestation. They make it improbable that many private interests will do much towards the afforestation of the marginal hill lands. It is, therefore, the more regrettable that the Forestry Commission, which has the financial and technical resources, is having to curtail its planting programme because sufficient land cannot be acquired.

OBSTACLES TO ACQUISITION OF LAND FOR THE FORESTRY COMMISSION

111. The difficulties of acquiring land for the Forestry Commission fall under four heads:—

General Difficulties of Acquiring Agricultural Land

112. Apart from scrub, devastated and felled woodland and a few waste areas, all the potential afforestable land is utilized to a greater or lesser degree by agricultural occupiers. Their enterprises range from very extensive sheep farms to small, uneconomic units on which the farmer derives only a subsistence living. But agriculture is the prevailing use, and there is a general reluctance to yield up land to a different purpose. Much potentially plantable land is farmed on the landlord and tenant system, and apart from the statutory protection of security of tenure, owners are reluctant to disturb farm tenants by agreeing to sell or lease parts of occupied farms, even on the least productive

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(1) Report of the Committee on Hedgerow and Farm Timber, 1955.

sections. Owners also object on grounds of estate management to disposing of islands or enclaves within their properties. Very substantial areas of land of low agricultural value, but capable of afforestation, are subject to some rights of common. Even when the rights are little exercised, there are strong practical and legal difficulties in acquiring the land free of such encumbrances.

Competition for the Type of Land required

113. Much land in which the Commission would be interested has some sporting value either alone or in conjunction with other land. This not only enhances the value of the land, but brings competitors into the field when the owners are willing to sell. Apart from agricultural and sporting interests, there are competing uses from other public bodies for land otherwise suitable for planting. These include the Service Departments' training areas and ranges; Ministry of Supply testing areas; Nature Conservancy Scientific Reserves; and Water Authorities' reservoirs and gathering grounds.

Special Administrative Arrangements

114. All proposals by the Forestry Commission for the acquisition of land are referred to the Agricultural Departments and in some cases to other Departments. In certain districts too, a number of official and semi-official bodies representing amenity interests (for example, the National Parks) have to be consulted. Restrictions consequently may be suggested which render impracticable an otherwise attractive proposal for afforestation. In any event the process of consultation tends to slow down the speed of negotiations with owners. Some negotiations for acquisition may fail from this cause. The prices offered and paid by the Commission for afforestable land are commensurate with the low market values prevailing for this class of land. Many owners are reluctant to sell despite the negligible income from such land, as it is felt that the land will continue to hold value in an inflationary world. An increase in the prices paid by the Commission over the prevailing prices might bring more land into the market, but on the other hand would arouse opposition from the farmers competing for such land. It might also tend to hinder the efforts of the Commission and the Agricultural Departments to secure the maximum integration of the two industries. This would be contrary to Government policy, and would inflate the Commission's costs. The purchase of large estates on behalf of the Commission, in consultation with the Agricultural Departments, allows for the optimum division of land between balanced agricultural units and afforestation. This is however only consistent with Government policy when a comparatively large area comes up for planting.

Hostility to Afforestation by the Commission

115. A good deal of land which otherwise might be available is not offered to the Commission because the attitude of the agricultural community to afforestation is one of suspicion, some of which is a natural reaction to some of the effects of afforestation, and some mere prejudice. The bulk of the land acquired for the Commission has been in complete farms, only some parts of which are plantable. To quote the wording of a criticism received in evidence by the Committee on Sheep Farming in Scotland (Cmd. 6494): " The Commission takes the 'eye' out of a farm"—i.e. in pursuit of maximum timber production the Commission, in earlier days, planted sheltered rough grazings which were previously capable of providing the rather scarce winter keep of sheep, and created problems of narrow and difficult access to the remaining

unplantable high grazings. In more recent years consultation between the Commission and the Agricultural Departments on the layout of plantations has undoubtedly improved matters: but the fear remains.

116. With the growth of afforestation in his neighbourhood, the farmer also fears an increase in the numbers of land pests which harbour in the plantations. This particular fear is not without foundation. Many farmers have until recently been shielded from such problems by gamekeepers in the service of neighbouring landowners: and much damage was tolerated uncomplainingly in the interests of sport, or was compensated by sporting interests. It is undeniable that in the absence of effective predators, the young conifer plantations are proving favourable nurseries for such pests as wood pigeons, carrion crows, magpies, jays and foxes. It is particularly difficult to dislodge foxes from extensive areas of close growing conifers. Nor are young, dense stands of conifers favourable to game management for sporting purposes. But forests of uneven age and mixed composition can be highly suitable for game, especially where the units are not too large. It is to be noted that the Commission gave a strong lead in the drive for the elimination of rabbits and more recently for the control of the grey squirrels.

117. Farmers who need to burn heather and rough grazings also fear the liabilities which they may incur if neighbouring plantations catch fire. Stock farmers resent the increased fencing costs which fall upon them when their land marches with plantations. Finally, there is a good deal of confused thinking on the effects of afforestation on the local population. On the one hand, some farmers feel that forestry will entice away the available agricultural labour; on the other, the local community may feel that its numbers will be reduced if farms are given over to plantation.

Forestry and Amenities

118. Projects suggested by the Forestry Commission have often been resisted, on the ground that afforestation impairs natural beauty, for instance in National Parks. It is argued that large, uniform, often straight-edged, areas of conifers would transform scenically attractive moorland or mountain into monotonous landscape. No simple generalization on this issue is possible, since subtle questions of aesthetics, as well as of local topography, are usually involved—though one might recall that in the eighteenth century persons of taste objected to " barren wastes," and supported land " improvement " and " plantations," as vigorously as their successors today reverse these judgments. We understand that the Forestry Commission is already adopting, for some areas, the policy of increasing the proportion of mixed plantations and the regeneration of hardwood stands. This should result in a variegated pattern, both in species and in tree growth, and should greatly assist the irregularity which is desired on scenic grounds.

Conclusion on Obstacles to Afforestation

119. These various sources of opposition to forestry are significant, even though some of them arise from legal and administrative problems and some from prejudice. They render it unlikely that, if present conditions continue, the national forest programme (which has already been slowed down) can regain the rate of planting originally envisaged. In particular they render it unlikely that the Forestry Commission will, in future, be able to obtain land in large tracts. The Commission has, in the past, preferred large contiguous plantations.

Extensive stands of timber cost less to plant, to protect, and to maintain and fell. Transport costs for the earlier operations, and particularly also for extraction, are lower. But, even if land were now obtainable for this kind of planting, the financial economies ought to be weighed against the social costs, and against the national benefit which might accrue from the alternative course of integrating forestry with agriculture. It may well be that the latter is not merely the only possible means of implementing the forest programme, but also the best means of dealing with the general problem of the marginal hill lands.

CASE FOR INTEGRATION OF FORESTRY AND AGRICULTURE

120. The crucial problems of the remote marginal hill areas are, first the difficulty of finding sufficient inducements to keep in such areas a sufficient and balanced population to exploit the more inherently fertile areas for agriculture; and second the problem of justifying the provision of communications, schools and social amenities on a scale which will make life tolerable to such a population.

121. To quote from the Report on Crofting Conditions (paragraph 241), " there are crofting townships on the western peninsulas of Ross and Sutherland which are already moribund, and which will be dead within twenty years unless immediate steps are taken to revive them. . . . The only authority or organization which is in a position to take immediate and effective action is the Forestry Commission ". This view admittedly refers to an extreme and desperate case. Typifying the more general problem of gradual decline of marginal hill areas, the Report on Mid Wales (paragraph 124) says " The social and economic fabric of the countryside has been weakened . . . the consequent disappearance of rural craftsmen has tended to increase the marginality of farming, which is dependent on the services of the rural community. The development of afforestation, properly integrated with agriculture, will strengthen the social and economic fabric of the countryside and assist materially in the rehabilitation of the upland areas ".

122. We suggest that the solution to the problem of marginal hill land which has been advocated in these two particular instances is broadly applicable to all similar land in Great Britain. The case for integrating afforestation with agriculture in the Western Highlands has been set out in paragraphs 236 and 250 of the Report on Crofting Conditions and the corresponding case for Mid Wales in paragraph 236(e), of the report on that area. The findings of these two reports agree with those to which our own investigations have led. By the term " integration ", as used in the remaining sections of this report, we mean something more than a mere increase of afforestation in these districts. We mean afforestation aimed at achieving the highest common factor of interests. We envisage arrangements by which the Forestry Commission is still precluded from planting land which is valuable to agriculture, but is at the same time encouraged to plant where shelter will be specially useful to agriculture. We hope that landowners will be prepared to sell to the Commission land suitably situated for plantations which will combine useful timber production with such shelter; or that they will be encouraged to create such plantation on their own land. We envisage that a pattern of land use would be evolved whereby:—

(a) the areas most remote from services would be given a bias towards afforestation; the remaining agricultural units would be designed to maintain a proper balance as between winter and summer pastures;

(b) in those areas which are less remote, the steep " side-lands " which are not essential to balanced agricultural units would be afforested in fairly large blocks, but allowing for sufficient access and shelter to surrounding rough grazings;

(c) finally, smaller areas would be planted, in which timber production was secondary to provision of shelter, both on high grazings and in the valley bottoms.

123. The benefits of integration are as follows:—

(a) The afforestation of the less fertile acres of such regions would provide the intervening farm lands with shelter for homesteads and livestock, and an extended grazing season in the shelter zone. The provision of tree shelter for mountain sheep flocks is increasingly recognized as of particular importance in reducing mortality in winter.

(b) It would also provide ready supplies of timber for fencing and other estate works, and for fuel.

(c) It would also allow of the sharing of equipment, the Forestry Commission lending transport and heavy implements to farmers, and the latter providing horses for forestry operations.

(d) A resident and co-operative farm population would reduce the needs of the Forestry Commission for staff by acting as fire watchers, etc.

(e) Integration would economize in capital services in as much as the roads and other main services which would be required either for purely agricultural or purely forestry development would serve both.

(f) Integration would lead eventually to economy in land use since the grazings improved by shelter would increase the wintering capacity in these areas and thus replace that of the actual area taken for planting.

(g) The intermingling of woodland and agriculture, and a greater irregularity in the size and configuration of plantations would prove welcome to those who have hitherto opposed " block " plantations on aesthetic grounds.

(h) Most significant of all, the integration of forestry and agriculture could help preserve the rural community. Even in its early stages, afforestation employs a great many more men per thousand acres than does pastoral agriculture. Foresty can thus:—

(i) provide a regular full-time or supplementary occupation for those members of the community who are under-employed at present; and would allow of the seasonal exchange of labour between forestry and agriculture operations;

(ii) bring in new blood and thus reverse the ageing of the local population;

and (iii) provide prospects of increasing prosperity, as the employment provided in maintenance of the forests, extraction of timber, and the wood-using industries will as the years go by increase much more than sufficiently to compensate for any likely economies in farm labour due to the amalgamation and mechanization of holdings.

124. These are the advantages of integration. But they must be weighed against the expense, for integration will involve higher costs than would the planting of trees in large compact areas. As we have already noted, if the highest common factor of the interests of agriculture and forestry is to be achieved, plantations will be less compact and more irregular. There will have to be salients into the larger plantations to preserve the best wintering grounds, and sheep walks for access to higher summer pastures (though these would also act as fire-breaks). Some small plantations will have to be sited principally to give protection to farmsteads. All this means longer forest fences⁽¹⁾ and more travelling time for foresters. We believe that the advantages outweigh the extra costs.

125. There is nothing novel in this conclusion. It has been accepted in principle by individual private landlords for generations, and would undoubtedly be more widely practised at present but for the external factors mentioned in paragraph 107 above. The Forestry Commission has been prevented so far from adopting similar practices on a wide scale because its terms of reference have been to grow trees for the single purpose of producing a reserve of standing timber; hence its plantations have hitherto had to be justified without reference to the benefits which trees might confer on adjacent agricultural land, or more generally upon the local community.

126. So far as present forest developments are concerned we are aware that arrangements exist between the Forestry Commission and the Agricultural Departments to ensure that, where the Commission purchases additional land, the agricultural interest is considered; so that land valuable to agriculture is not included in planting plans. In a few places (some of which are described in Appendix VI) active steps are being taken towards positive integration. We are glad also to note the announcement (Hansard 14th July, 1955, column 2235) that the Forestry Commission is to be specially authorized to undertake plantations in the Crofting Areas "even if this means, in some instances, planting on land which will give a smaller return than is normally looked for". However, we consider that this policy should be adopted as a national policy for marginal land rather than just in respect of land which the Commission would, according to its present objective, wish to plant, or as a local solution in areas where the social situation is already desperate.

MEANS OF FORWARDING THE FORESTRY PROGRAMME AND INTEGRATION

127. We have set out in the foregoing sections our reasons for believing:—

(i) that the isolated agricultural development of our marginal hill lands may constitute an uneconomic outlay of capital, and

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(1) Fencing of young plantations against rabbits is a major expense, especially with smaller areas. If the wild rabbit population could be kept down, the developments advocated here would be considerably cheapened.

further that such development may in the end fail to arrest declining soil fertility;

(ii) that the concentration of development on one form of occupation does not conduce to the maintenance of healthy social communities;

(iii) that it is in the marginal hill areas that suitable tracts exist for the afforestation which is required in the national interest;

(iv) that the integration of forestry and agriculture would bring benefits to both.

128. The obstacles to the achievement of the forestry programme have also been discussed. The most important are:—

(i) that the rural population is often hostile to the creation of new forest plantations;

(ii) that private land owners cannot as a rule afford the cost of planting and the cost of maintaining plantations;

(iii) that the Forestry Commission, which faces considerable difficulties in acquiring land, is not in general expected to incur additional costs for the sake of benefits which would accrue to agriculture and to the rural community.

MORE LAND FOR FORESTRY

129. The answer to the problem of finding land for forestry must lie in convincing the people who own and live in areas which are marginal for agricultural purposes that forests are an asset. As we have seen, the activities of the Commission still sometimes provoke suspicion and even hostility. The Commission thus needs to make great efforts to develop the goodwill of the agricultural community. For instance, in some circumstances it would be desirable for the Commission to go out of its way to demonstrate, on properties which it acquires, that it does not wish to plant trees on the last acre for which it can obtain clearance from the Agricultural Departments; that it is prepared to create plantations which are specifically designed to aid farming; and that it is anxious to press on with its educational and advisory work. It might also be useful if the Commission, in some instances, accepted more than its strict legal obligations for fencing, fire damage and control of vermin.

130. Since it does not seem that the Commission can now expect to get anything like the acreage required for its planting programme in the form of large blocks, efforts should be made to obtain those parcels of land which can best be spared from individual farms within the marginal hill areas. In aggregate there is a large area of land which is too steep, broken, or thin for mechanical improvement. There are, indeed, many places where continuous if narrow bands of steep " side lands " lie between valley fields and hill-top pastures. These are of little use to the farmer, and are frequently infested by bracken or gorse. Even allowing for adequate access to the upper pastures, they could provide a large and not unduly costly planting area, often without taking more than a small and unprofitable section of land out of adjacent farms. At the outset a search should be made for such sites as are close to the Commission's present properties and to existing woods.

131. As we have pointed out in paragraph 67, the Forestry Commission has already begun to buy a certain amount of land in small blocks. This

policy should be pursued more extensively than it already is. At the same time the Commission might on occasion plant small areas because of their resultant value to agriculture even where it would not be economic purely from the point of view of timber production.

132. In certain areas where it seems likely that the integration of forestry and agriculture could yield most benefit, a case might be made out for an appropriate authority to acquire, for the purpose of demonstration, one or two farms which include land that could be reclaimed for planting. The object would be to show how a proportion of the rough grazing of a hill farm can be devoted to afforestation without decreasing the total grazing capacity of the farm. Additionally, when the opportunity arose, the Authority might purchase adjacent farms with the object of demonstrating the selection of land for afforestation so as to leave a smaller number of more economic holdings for agriculture. In either event there would seem to be no need for the State to continue to own the agricultural land once the plantations had been marked out.

133. We understand that the Commission is as much concerned to encourage the creation of new forests on private lands as it is with the development of State forests. It has been suggested to us that there are a good many private land-owners, who are not prepared to dispose of the freehold of suitable areas of land, but who would be quite willing to lease land to the Commission for a period of, say, 99 years at the equivalent of its grazing value, for the sake of the shelter the plantations would afford to stock, and providing that satisfactory conditions in respect of fencing, fire risk and vermin could be agreed. It might be possible for the Commission to acquire a substantial area of land in this way.

134. We have already emphasized in paragraph 107 that in these days few private landowners can afford to go in for tree planting. We do not, therefore, think that under present conditions private owners are likely to play much part in the integration of forestry and agriculture in marginal hill lands. Even with a 50 per cent grant available (under the Hill Farming and Livestock Rearing Acts) towards the cost of establishment of shelter belts, very few proposals for such improvement are received. And since large landowners find some difficulty, even with the aid of grants, in financing the restocking of their plantations, it is altogether unlikely that the owner-occupiers of small marginal farms would be prepared to provide any significant part of the financial cost of planting trees. Even a larger grant than 50 per cent of cost might have very little response. And it would clearly be unwise to go too far in subsidizing a purely private venture whose success depends on a long period of careful maintenance. If trees are to be planted on private land in these regions some new measures are therefore required. We believe that a new policy of afforestation can be defined, which would enable private or communal owners in these marginal areas to produce timber on their own land, and to acquire over a period of time the necessary knowledge of the techniques of maintenance. Wherever possible the Forestry Commission already assists private and co-operative afforestation by secondment of staff and loan of labour and equipment. What is needed in addition is a full measure of assistance over the capital costs and risks of tree planting, in return for a sufficient period of control over management. More attention will also need to be given to an adequate supply of sound seedlings for private purchase: in recent years shortages have held up private planting.

135. We have been interested to see the Forestry Commission proposals already formulated for the creation of " Parish Forests " on common land.⑴ A scheme on much the same lines might be applied to land in the marginal hill areas held by owner-occupiers.

136. At the request of the owner, the Forestry Commission would draw up a plan for planting suitable parts of a farm, with an estimate of the costs of planting and maintenance. This scheme would then be submitted as the basis of an application for a government loan. If the application were agreed, the money " loaned " would be earmarked to be drawn upon by the Forestry Commission, who would carry out the work of planting and maintenance, either directly or by supervised contract work. Some of the labour might, in fact, be supplied by the farmer himself. Indeed if the owner had the ability to undertake the contract himself, it might be let to him. It is hardly likely, however, that this would apply at the outset in many cases. The owner would, for the time being, have surrendered effective control of the planted areas and a low rate of compound interest would be added to the loan, so far as it was taken up, to cover the costs of the work. The Commission would remain responsible for the supervision of the plantation until the sale of the produce of the plantation had repaid the capital and interest on the loan. The loan would not, however, be foreclosed unless the owner interfered with the management of the plantation by the Forestry Commission. If the plantation proved to be a failure (that is, if it failed within a reasonable period to repay the loan) the loan would be cancelled. The main advantage of such a scheme as compared with the lease of the land by the owner to the Commission, is that it gives the owner a personal interest in the success of the plantation, and that it is therefore likely to encourage him to learn something of the business of forestry.

TECHNICAL EDUCATION AND ADVICE

137. The implementation of our present policy of afforestation clearly implies that an increasing number of people will be employed in forestry work. We have suggested that one of the advantages of the development of forestry in the marginal hill areas is the resultant diversification of employment in these areas. At the same time we have noted that ignorance of forestry is one of the obstacles to its development, and that there is a tendency for British agriculturists to be indifferent to the techniques and practices of forestry. If this applies to landowners and large-scale farmers, it almost inevitably applies with greater force to the occupiers of marginal hill farms whose skill is especially concentrated on stock-rearing, and who have less opportunity of extending their technical knowledge of trees.

138. If the integration of agriculture and forestry is to occur on a wide scale, farmers will need a greater knowledge of forestry than they now generally have. There is a special need for education and advice on forestry matters to be readily available to the people of the marginal hill areas. Moreover the possibilities of forestry should be very much in the mind of the Agricultural Advisory and Educational services. Advice on the possibility of fitting plantations into the farm plan should be as readily available to farmers and landowners as advice on any other point of farm management. For those private persons who are interested in carrying out the work themselves, there should be follow-up technical advice on planting and maintenance. Those who prefer

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⑴ In evidence submitted to the Royal Commission on Common Land.

to hand the job over to the specialist should be encouraged to get in touch either with a private contractor or with the Commission. There may also be scope for giving more weight to the policy of integrating forestry with agriculture in those official advisory publications which reach a wide farming public.

PROBLEM OF THE UNECONOMIC FARM

139. It is reasonable to suppose that by means such as those suggested in the foregoing paragraphs, the marginal hill lands might be put to better use than they are today; that a good deal more land might be found for forestry; and that the social benefits which would accrue might help to stabilize the rural communities in these areas. Not least important would be the opportunities created for occupants of uneconomic farms to find part-time employment in forestry. But only to that extent do our suggestions help with the problem of the uneconomic farm.

140. If the problem of the uneconomic farm is to be dealt with effectively a more fundamental remedy will be required. The trouble with many of these farms is not merely their small size but also their configuration. Furthermore, many holdings originally of a reasonable size have been divided and redivided at successive stages of inheritance. In relation to the technical requirements of present-day production, farms and fields in these marginal areas are generally much too small and frequently quite irrationally arranged. One effect of this sporadic development is that the movement of equipment cannot be planned well ahead and heavy haulage costs are incurred. It is in fact the pattern of occupation rather than the nature of the land itself which makes farming so generally unprosperous in the marginal hill areas.

141. This pattern is slowly being changed by economic pressure. Remote farmsteads are being abandoned and their fields joined to those of more favourably situated neighbours. To the extent that this process results in larger holdings, it generally constitutes a rough and ready improvement of the situation, even though for the time being it may lead to the land being insufficiently used for lack of capital.

SUBSIDIZED IMPROVEMENTS

142. It is, however, unfortunate that this natural process of amalgamation is almost inevitably haphazard, and that the capital subsidies now available for the improvement of hill and upland farms cannot be effectively geared to the rationalization of farm boundaries. These subsidies—under the Hill Farming Act 1946—are payable to individual owners in respect of the development of individual holdings. There are, of course, provisions designed to ensure that the subsidies are applied to holdings which will, at least, be capable of providing an agricultural worker's wage. However, these provisions are difficult to administer because there is frequently a very wide range of doubt as to how much income a particular holding would be capable of producing if circumstances were altered by capital improvement. A great deal obviously depends upon the knowledge and acumen of the person who is occupying the farm at the time. In such circumstances the administrators are bound to give the benefit of the doubt to any one who puts forward a scheme of capital development with any measure of enthusiasm. A scheme cannot be rejected on the grounds that a

much better scheme could be produced if the farm boundaries were changed by exchanging land with neighbours, nor on the grounds that the only logical method of development is to develop all the neighbouring farms together, with a general reorganization of the field pattern and the re-siting of services and buildings. The individual holding has to be taken as it stands. The effect is an almost random scatter of improvement; and a proportion of the grants made probably serve only to prolong the separate existence of basically uneconomic holdings.

FREEHOLD AND LEASEHOLD RIGHTS

143. In a sense this is an inevitable result of the public attitude to private rights in the land. So long as private rights, applied rigidly to particular plots of land, are deemed more important than the full development of the potential productivity of the land, it is unlikely that there will be any rapid improvement in the distribution of land between farms. The consequence is not only that public subsidy and a good deal of private money is being sunk in patchwork development but also that many of the occupiers of these hill farms are leading an unnecessarily hard existence and many are migrating to the towns.

FARMS BOUNDARY REORGANIZATION ABROAD

144. Other nations face similar problems, and in many European countries they are even more acute than our own. If only for that reason, they have been more widely recognized and more actively dealt with.

145. We have been particularly interested to learn of arrangements in France to couple farm boundary reorganization with the re-creation of forests in marginal hill areas. Loans are provided for the establishment of small forest blocks on derelict farm lands and the work of plantation and management is undertaken by the Forestry Service of the Ministry of Agriculture in much the same way as we have suggested in paragraph 136.

146. We have also been much impressed by the bold and thorough provisions for re-allocation of agricultural land in the Netherlands. There the task of reorganizing farm boundaries is under the direction of a central government committee served by a special " Land Consolidation " service. The importance to the farmer and to the nation of making the best use of the land is fully recognized. Reorganization schemes include the rectification of farm boundaries to give compact units of economic size, the re-siting of farmsteads, roads, and drainage dykes, as well as the planting of timber strips and blocks for shelter bolts. (It is interesting to note that, in spite of an acute scarcity of land, fertile or otherwise, the Netherlands devotes almost 8 per cent of its total area to growing trees.) The increase of agricultural efficiency is not the sole object of the reorganization, which also aims to preserve, and where possible to increase, rural amenities. By the end of 1954, reorganization schemes had been completed for some 200 000 acres and further schemes covering well over a million acres were in preparation or under consideration.

147. Obviously reorganization of farm boundaries in the marginal hill areas of Great Britain would not be as straightforward a project as it is in the flat, reclaimed lands in the Netherlands. Nor could it go forward without a change in our attitude to freehold rights in the land. It is interesting to note that the arrangements in the Netherlands provide that, at the conclusion of a reorganization scheme, each of the original occupiers of the land should be in possession

of a holding, the value of which is proportionate to his holding before the scheme was initiated, although it may comprise little, if any, of the actual land of his original holding.

148. A close study of the methods and results of farm boundary reorganization practised in the Netherlands and other European countries, and of their applicability to conditions in this country would seem very worth while.

CONCLUSIONS

149. The field that has been covered by the present report is marginal in the extent to which it figures in the financial affairs of the country, and all but marginal to the preoccupations of the bulk of the population. The issues raised are nevertheless vital to our national well-being. Increasing rural depopulation: and in some cases virtually the total depopulation of vast hill areas that were once actively worked: an acreage of forests and woods which in total extent covers relatively less of our land surface than does the tree-cover of every other European country, including even Holland: yet obstacles to afforestation which unless overcome imperil the fulfilment of our forestry programme: and a declining interest in the farming of marginal hill farms, in spite of the fact that these constitute a main breeding reservoir for the cattle and sheep reared on the lowlands—these trends have already changed the pattern of our national life, and will do so at an increasing rate if they continue. The social and physical effects of the transformation that has already taken place have been regretted and deplored by all the official bodies by which they have been considered. From the economic point of view the extent to which they are tolerated nationally is simply a reflection of decisions, implicit rather than overt, that the resources necessary to prevent the ill effects of the under-use of our marginal lands are in present circumstances better directed to more profitable causes. But in the long and short term the neglect of our marginal land, however remote it may often be geographically, represents a neglect of natural resources whose cultivation might be urgently called for in conditions of blockade, or if our position in world trade were to worsen materially.

150. The main conclusion of our study is that each item of forestry and agricultural development in marginal land should be planned as a cohesive operation. Next in importance is the view that end-uses for forest products additional to those that are already being exploited should be found.

151. Opinion is undivided that our first conclusion implies a greater demand for, and a greater diversity of rural labour, with richer opportunities for those who would continue to live in the outlying areas concerned. In turn this implies more economic investment on social services, such as roads, schools, and health; and the need to find effective measures for dealing with those farm-holdings which are uneconomic either because they are too small or too badly laid out. The second point that we have underlined here refers especially to pulping mills. The technical and economic problems that have so far deterred their establishment in this country can hardly be insuperable. The initiative for which their solution calls would in itself do much to revivify interest in useful investment in our marginal lands.

152. The State accepts a large measure of responsibility for the use of this land and for the welfare of the people who continue to inhabit it. Much public

money is channelled to these areas by such Government bodies as the Agricultural Departments, the Ministry of Housing and Local Government and the Forestry Commission. It is implicit in what we have already said that the Departments of Agriculture and the Forestry Commission in these districts should in future co-operate even more closely than they have in the past. It has been argued that there is a need for a new genus of executive body which would discharge all administrative responsibilities, including those of the central Government Departments in marginal hill areas. While we recognize that there is a need for close consultation at regional levels between the Departments concerned, we do not subscribe to this view. Events are already moving in the direction of greater co-ordination, and it will be time enough to consider the need for a new type of administrative machinery when, and if, it becomes national policy to divert to our millions of acres of marginal and hill land a greater proportion of national revenue than they now attract. In the long run the value of this land to the nation is bound to appreciate, rather than decrease, as the demand for food and timber increases in the world.

SUMMARY

INTRODUCTION

The present report summarizes the results of an extensive study of the problems involved in increasing the use of indigenous sources of timber, and of the repercussions of afforestation on the agricultural use of marginal land. (Paras. 1–5).

BACKGROUND OF AGRICULTURAL POLICY

During the 1939–45 war the main goal of agricultural policy was the maximum output of milk and of crops for direct human consumption. The emphasis of the post-war expansion programme has shifted in recent years to the production of livestock. The hill and upland livestock rearing areas are of vital importance to this policy, of which the general aim is to achieve the greatest economic production possible. (Paras. 6–10).

FORESTRY BACKGROUND

It has long been customary to import most of the timber we use, but shortages in two world wars have emphasized the need for domestic supplies. The Forestry Commission were therefore charged in 1945 with a fifty-year planting programme designed to supply essential requirements of timber, given that we might once again have to fight a war of several years' duration. Strategic considerations have changed since then, but on the other hand, there is a greater economic reason now, than before, for investment in the planting of trees. (Paras. 11–23).

UPLAND MARGINAL LANDS OF GREAT BRITAIN

The upland districts of Britain are already sparsely populated, and the trend is towards further depopulation. Soil fertility in these areas is generally low, and in some districts is progressively deteriorating. In view of the ever-recurring threat of trading difficulties, we cannot view with equanimity the under-use, amounting in places to abandonment, of much marginal land made up of rough grazings and waste lands. These categories of land, extending over 20 million acres, constitute almost two-fifths of our land surface. (Paras. 24–34).

POSSIBILITIES OF AGRICULTURAL DEVELOPMENT

Various surveys of rough grazings and marginal land have shown that the productivity of some 4 million acres could readily be improved, and that much of this land could be dealt with at less than £30 per acre.(1) These acres play an essential part in domestic meat production as a breeding and rearing ground for cattle and sheep, and their depopulation is a source of increasing anxiety. Population and agricultural production can be maintained only by more capital investment, but the development of agriculture will not, by itself, be sufficient to correct the situation. (Paras. 35–46).

DEVELOPMENT OF FORESTRY

Although physical conditions in Great Britain are more favourable to the growth of trees than in many European Countries, the proportion of the land surface of Great Britain which is under forest is less than in any other Western European country. Even so, much of the land classified as woodland is at present unproductive. The planting programme of the Forestry Commission is, however, being delayed by the difficulty of acquiring suitable land. It is estimated that more than 4 million acres of rough grazing are suitable for afforestation. Much of this land is on livestock hill farms, but areas of coppice and commons also provide opportunities for forestry. (Paras. 47–70).

FINANCIAL RETURN FROM AGRICULTURE AND FORESTRY

Comparisons between the financial returns of agriculture and forestry are difficult, because of the great difference in the length of their production cycles. Studies by the Committee of a number of selected areas in Great Britain suggest that on marginal upland areas, forestry may have a slight advantage over agriculture in returns on invested capital. Although the assessment of the relative import-saving value of forestry and agriculture on such land is very difficult, in the long term, forestry would apparently show an advantage over agriculture. (Paras. 71–76).

MARKET FOR HOME-GROWN TIMBER

Imports of wood and wood products cost at present about £430 millions per annum, including about £180 millions for saw timber. There is likely to be a continuing domestic demand for any sound commercial saw timber that can be produced, and even the Foresty Commission's full programme of five million acres of productive forest would meet only one-third of present requirements. The main problem is to dispose of the increasing quantity of thinnings. A substantial proportion will continue to be used for pit-props, and new factories are being erected for the manufacture of building board and chip board. Wood pulp for paper and for man-made fibres comprises a large part of our imports of timber products. If certain technical difficulties were solved, there would appear to be scope for a substantial increase in the production of wood pulp for paper.

Other home sources of pulp for paper production are waste paper and surplus straw, but these are unlikely, in normal circumstances, to provide a greatly increased contribution to our supplies of pulp. Commonwealth sources of pulp, particularly rayon pulp, are likely, however, to continue to be competitive with home-produced supplies. The further development of wood pulping plants in this country based on the use of home produced timber will depend on the economics of relatively small scale pulping units and on the encouragement given by the home timber industry and by appropriate Government Departments to the establishment of such factories. (Paras. 77–105).

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(1) At the prices ruling in 1949 when the relevant survey was carried out.

OBSTACLES TO AFFORESTATION

A number of practical difficulties are hindering the Foresty Commission's planting programme and the development of private woodlands. Lack of immediate financial advantage, the need for large capital investment, and the shortage of skilled forest workers make it improbable that private interests will engage in afforestation to any significant extent.

The programme of the Forestry Commission is hampered by the difficulty of acquiring suitable land; by competition from other interests for the type of land required; by the need for extensive consultation before acquiring land; and in some areas by the hostility of local people to the idea of afforestation. If present conditions continue, it is unlikely that the rate of planting originally envisaged will be achieved. (Paras. 106–119).

INTEGRATION OF FORESTRY AND AGRICULTURE AND THE MEANS OF ACHIEVING IT

A number of reports concerning particular areas in Scotland and Wales draw attention to the importance of forestry, when properly integrated with agriculture, as a means of strengthening the social and economic fabric of the countryside. The Committee regard this as generally applicable to all similar land in Great Britain. Afforestation of the less fertile areas of such regions would provide shelter for livestock and supplies of timber for fencing, etc. It could also lead to economies in capital services such as roads and schools; to an increase in the rural community; and to the possibility of sharing heavy equipment between forestry and agriculture. Even though integration would involve higher costs of afforestation than the planting of trees in large compact areas, the advantages appear to outweigh the extra costs.

If proper integration is to be attained, the Forestry Commission and the Agricultural Departments would have to co-operate more closely in the future than they have in the past. A few farms might be used for the purpose of demonstrating the value of the policy of integration to the agricultural community. The Forestry Commission might also assist private owners by undertaking forestry development on an agency basis, with the possible assistance of Government loans. Technical advice on the advantages of forestry should also be more readily available to landowners and farmers.

If the best use is to be made of our marginal hill lands for forestry and agriculture, attention will have to be directed to the continuing existence of small and uneconomic farm units. The Committee believe that the solution of this problem is closely related to the integrated use of marginal hill land for forestry and agriculture which they advocate. (Paras. 120-148).

APPENDIX I

LAND USE IN THE HIGHLANDS OF SCOTLAND AND IN CENTRAL WALES

THE SCOTTISH HIGHLANDS

1. The counties of Argyll, Inverness, Ross and Cromarty and Sutherland cover almost eight million acres, over 14 per cent of the total land area of the United Kingdom. Their population (220 000) however, is only 0·4 per cent of the Great Britain total and they carry only about 1·5 per cent of our total number of cattle and 8 per cent of our sheep. The area under 'high forest', 250 000 acres, comprises less than one-tenth of our total.

2. Table A overleaf shows the detailed figures for the separate counties. Over the whole area of the four counties the average population is less than three people to 100 acres. In the remote hill farms only one man is employed for about every 4000 or 5000 acres. The number of sheep and cattle were taken at the June census, and therefore show these at their maximum. Even so, the stocking density in June is only one cow to forty-eight acres and one sheep to over four acres. Only three per cent of the area is under 'high forest': but a further 3½ per cent is classified as woodland in need of replanting.

CENTRAL WALES

3. The rural development panel of the Council for Wales and Monmouthshire in a recent report (Cmd. 8844) described a pilot survey of an area comprising parts of the counties of Cardigan, Montgomery and Radnor, 715 000 acres in total. The population of the area is 62 000. The woodland total is remarkably small, namely 25 000 acres of Forestry Commission woods and 18 000 acres of private woodlands. Figures for cattle and sheep in this area are not available, and undoubtedly the sheep figure would show a fairly high density of stocking.

4. A smaller area, of some 300 000 acres, has been investigated in greater detail by the Welsh Agricultural Land Sub-Commission. Their report (Cmd. 9631) includes the following information:—

(a) *Land Use*

	Acres
Tillage	17 556
Permanent and temporary grass	64 159
Rough grazings in sole occupation	180 200
Common grazings	15 282
Forests, woodlands, other non-agricultural areas and inland water	22 614
Total	299 811

(b) *Population*

The total population in 1951 was 10 646 (or a little over one person to thirty acres) compared with 12 232 in 1931, a drop of about 13 per cent.

TABLE A

	Area '000 acres	Population '000	Forest area '000 Acres				Bare land held for planting Forestry Commission '000 acres	Numbers of cattle	Numbers of sheep
			High forest		Scrub, felled and devastated woods			'000 head	
			Private	Forestry Commission	Private	Forestry Commission		June Census 1954	
Argyll	1990	60·1	22·9	74·7	54·2	5·7	18·3	64·7	706·6
Inverness	2695	85·5	38·7	47·6	114·3	19·5	8·0	52·1	572·2
Ross and Cromarty	1977	60·2	17·1	33·7	45·5	4·6	3·4	40·3	416·1
Sutherland	1298	13·9	7·0	4·8	17·2	1·5	2·0	9·8	232·2
	7960	219·7	85·7	160·8	221·2	31·3	31·7	166·9	1927·1

(c) *Agricultural Units*

There were 1693 agricultural units in 1953 (or about one unit to every 160 acres of agricultural land) compared with 1868 in 1931, a drop of approximately 10 per cent.

(d) *Livestock*

On the other hand there were 25 009 cattle and calves in 1953 compared with 22 747 in 1931, an increase of almost 10 per cent and 358 038 sheep and lambs in 1953 compared with 305 220 in 1931, an increase of about 14 per cent.

(e) *Forestry*

There has been little development of private forestry, except in the Birmingham Corporation's catchment area. The Forestry Commission has so far afforested 13 321 acres, or less than 5 per cent of the total area.

APPENDIX II

EXAMPLES OF COSTS AND RETURNS OF IMPROVING MARGINAL HILL LAND FOR AGRICULTURE

A. IMPROVED AREAS ON DOLFOR-KERRY HILLS

1. The data set out below refer to a number of enclosed rough grazing areas on the Dolfor-Kerry hills, which were reclaimed during the period 1940–44.

2. The original vegetation was of various dominant types such as bracken, gorse, *Nardus*, *Molinia* and fescue.

3. While the results during the last 10 to 14 years show considerable variation, related in part to the original vegetation and soil type, the figures given below are averages for all the areas in order to avoid the main results being confused by unnecessary detail. The fertilizer rates and costs per acre included in these calculations would, however, only apply to one or two of the better managed areas and are therefore generous as average figures.

4. The costs of ploughing, cultivations and fertilizers at 1954 prices are set out in Table B below, which also shows the average costs per acre improved for 6 and 9 year periods.

5. Attempts have been made to assess the productivity of these areas by collecting data relating to:—

   (i) the yield and chemical analyses of the dry matter;
   (ii) the actual stock carrying capacity;
   (iii) liveweight increases in relation to (ii) over a limited number of years.

6. In assessing the economic value of the returns, any of at least three methods might have been used:—

   (a) the stock carrying capacity valued at so much per cattle beast equivalent per week;
   (b) the liveweight increase valued at so much per lb;
   (c) the nutritive value of the herbage expressed and valued at so many cwt. of Starch Equivalent per acre according to the numbers of stock actually carried and presumed to be in a growing and thriving condition.

7. Method (b) has been used as a basis for comparing costs and returns in Table C below. It must, however, be made abundantly clear that this comparison of costs and returns relates to *reclaimed land only* and has nothing to do with any improvements that might have been carried out or would be required on the parent holding. In this connection the following points can also be made at this stage:—

   (i) This exercise applies to areas of rough grazing land, averaging in size about 100 acres, which are now attached to separate individual holdings.
   (ii) No allowance has been made for fencing costs as no new fences were required, but a very small charge per acre might have been allowed to cover the cost of renovation and maintenance.
   (iii) No charge has been made for machinery, maintenance and depreciation, as the costs are based on contract charges.

TABLE B

(a) Fertilizer Costs Detail

	Price/Ton £ s. d.	Subsidy/Ton £ s. d.	Nett Price/Ton £ s. d.	
Slag 15 per cent...	6 18 6	2 6 0	4 12 6	say £5
16 per cent...	7 5 0	2 8 0	4 17 0	
17 per cent...	7 12 0	2 10 0	5 2 0	
Nitrochalk	15 14 0	2 13 6	13 0 6	say £13
Lime (Ground Limestone)	2 18 0	1 9 0	1 9 0	say £1 10s. 0d.

Above prices from F.W. 15/10/54

Spreading cost taken as 12s. 0d. per acre per dressing

(b) *Method of cost—calculation* (for direct reseeding without pioneer crop):

	Gross £ s. d.	Subsidies £ s. d.		Nett £ s. d.
(a) Ploughing and cultivations	8 0 0			8 0 0
(b) Manures and lime, including spreading	14 2 0			
10 cwt slag...		1 4 0		
2 tons lime...		2 18 0		
2 cwt nitrochalk		5 6		
		4 7 6	say	10 0 0
(c) Seeds mixture	5 2 6		say	5 0 0
Total	27 4 6		Total	23 0 0
Less Ploughing grant				10 0 0
				13 0 0
= Cost per acre per year (spread over 3 years)			say	4 7 0

(c) *Continuing costs after reseeding*

Fertilizers used during each 3 year period after reseeding—

		(1) To Farmer £ s. d.		(2) To Nation £ s. d.
some nitrogen (2 cwt nitrochalk £1 6s. 0d. and 5 cwt slag £1 5s. 0d. = £2 11s. 0d.) + 24s. 0d. for spreading	=	3 15 0	say	5 0 0
Total area 6 years	=	16 15 0	,,	32 0 0
Cost/acre/annum	=	2 16 0	,,	5 3 0
For 9 year period	=	20 10 0	,,	36 0 0
and cost/acre/year	=	2 5 0	,,	4 0 0

(iv) In Table C it is assumed that the farmer owns the stock and will have to keep and house these on the parent holding. For this purpose extra produce will have to be grown on the enclosed land or purchased for winter feeding. It is also assumed that the cost of such food should be set against the increased value of the stock the following spring. In the example below the improved areas are not credited with any value for the additional winter grazing they can and do provide or for the fact that in many cases the farmers have been able to improve considerably the quality of the stock kept, especially the type of breeding ewe.

(v) The returns in Table C are based on the *increased* stock carried after improvement.

8. Nationally this land could be *either* planted with trees *or* could be improved for agricultural use to give returns of the order shown in the tables below.

Table C

The average costs and returns per acre per year over six and nine year periods to (a) the farmer and (b) the nation, assuming that the returns on a liveweight increase basis are valued at 1s. 3d. per lb.,

			To Farmer	To Nation
(a)	Annual charge, if land improvements are spread over a 6 year period		£2·8	£5·3
	Stock losses and replacements		£0·1	£0·1
	Labour for stock		£0·3	£0·3
	Depreciation and maintenance of building		£0·3	£0·3
			£3·5	£6·0
	Returns based on average liveweight increase of 130 lb. per acre		£8·1	£8·1
	Difference		£4·6	£2·1
	Percentage return on capital	=	$\frac{4{\cdot}6}{16{\cdot}75}$	$\frac{2{\cdot}1}{32 \text{ approx.}}$
		=	approx. 27%	6·5%
(b)	If the costs of land improvement are depreciated over a nine year period, the approximate returns on capital are		20%	6·3%

B. RETURNS FROM IMPROVED AREAS IN TERMS OF THEIR INCREASED STOCK CARRYING CAPACITY—MONTGOMERYSHIRE AND SHROPSHIRE

9. A recent survey of reclaimed rough grazing areas in Montgomeryshire which, in their original state, carried one breeding ewe per acre, has shown that the stock carrying capacity has been increased on these areas by at least 300 per cent over a nine year period. Similar areas over the border, in Shropshire, have shown even more spectacular improvements. Here the increase has been of the order of six or seven hundred per cent, that is, double that obtained in Montgomeryshire. The reason for this is partly the better quality of the land, but mainly that the Shropshire farmers have hitherto been much more generous in their use of fertilizers. On the Montgomeryshire areas the average annual expenditure on lime and fertilizers was only about 6s. 0d. per acre, while the corresponding figure in Shropshire was £3 per acre. At current prices of fertilizers and livestock, the greater expenditure by the Shropshire farmers will have undoubtedly paid handsome dividends.

APPENDIX III

METHOD OF COMPARING FINANCIAL RETURNS FOR AGRICULTURE AND FORESTRY ON MARGINAL LAND

Paragraphs 74 and 75 of the report are based upon investigations and calculations carried out over a period of several years and resulting in a considerable volume of figures and discussion. The following is an outline of the method used:—

(a) Costs and returns were calculated mainly on wages and prices ruling in 1951. No account was taken of capital grants available for either agricultural improvement or dedication of woodlands, but the agricultural prices inevitably included some element of subsidy: just how much could not be assessed since the period was one of fixed producers' and consumers' prices for the staple agricultural products.

(b) Marginal land districts were chosen where forestry and agriculture are practised side by side.

(c) For example, areas were chosen in the New Forest in which agriculture and forestry were in progress on similar soil and under other external conditions which were as nearly the same as possible. Estimates of agricultural costs and returns were based on operations carried out on land specially enclosed by the Agricultural Executive Committee, the actual figures being modified so as to discount the deviation from normal farming practice imposed by the special circumstances. Calculations of forestry costs and returns were based on areas of standing forest with the assumption that the forest crop would be carried on to maturity.

(d) In the Kerry Hills a group of existing farms close to the forest area were surveyed and the possibilities of agricultural development compared with the operations of the Forestry Commission over the whole Kerry forest area. The assessed possibilities of agricultural development were based on recommendations for improvement of the same farms made in the course of a survey in 1949. Estimates were made of the cost of improvement (including improvement of fixed equipment) and of the level of productivity which might be expected to result from them, revalued at 1951 prices. The costs and returns of afforestation were based on average results achieved for various species of trees, again valued at 1951 prices, and with the assumption that a continuous cropping policy would be maintained.

APPENDIX IV

MATERIALS OTHER THAN TIMBER FOR PULPING

WASTE PAPER RECOVERY IN THE UNITED KINGDOM

1. Waste paper and cereal straw are two indigenous materials from which we obtain, or can obtain pulp. The former has for many years been recovered and repulped in large quantities, but straw, except in war-time, is used on a relatively small scale.

2. The contribution which waste paper makes to our economy is considerable. Consumption in 1955 was in fact equivalent to almost one-third of the fibrous materials used by the whole paper and board industry. But although some is lost through exports, storage, burning, and in other ways, there seems little doubt that the amount of paper recovered could be increased. Increased collections can, however, only proceed step by step with the ability of the mills to utilize increased supplies, and provided that prices are at a level at which the mills can produce economically.

3. Waste paper has been increasingly used as an alternative to mechanical wood pulp mainly in " board " manufacture, and only to a limited extent as a substitute for the more expensive chemical pulp used in paper-making. But better selection and utilization is necessary if waste paper is to contribute more to the saving of imports. It can do so only if the better grades are used in paper-making rather than for board-making. The critical problem is to find better means of collecting and sorting. There is no problem from the point of view of usage. In fact the capital expenditure in equipping mills to reconvert waste paper to pulp is considerably less than that required for installing first-hand pulping plant of equivalent capacity. If the higher grades of paper in recovered waste were used at paper mills, this would replace from 40 000—60 000 tons of imported chemical wood pulp and, by the further inclusion of waste in the lower class papers, a similar quantity of imported mechanical wood pulp. At present prices the resultant import savings would be of the order of £4 to £5 millions. (1)

4. One way of increasing the use of waste paper that has already been used for printing is to print with easily removable inks. In this way losses in repulping are reduced, and greater proportions of repulped printed waste may be incorporated in the pulp from which new paper is made. This practice is common in the U.S.A. and might be introduced here. A trial printing of telephone and other directories with these inks, made in consultation with the Research Associations, would tell how far this practice could be applied in our own country.

CEREAL STRAW

5. Our second source of raw material for pulp is cereal straw, of which over six million tons are produced annually. There are, of course, established uses for straw other than for pulping. Also two new factors, the increasing popularity of new short stemmed varieties of wheat and barley, and the increasing use of combine harvesters, which normally leave the straw in the ground, may tend to diminish the quantity of straw available. However, both the Ministry of Agriculture and the farmers consider that 500 000 tons of straw could be made available annually for pulping, particularly if contracts for supply could be

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(1) The figures are based on 1955 calculations

placed before the harvest. If this quantity of straw were used for pulping it would represent an import saving of over £8 millions.

6. During the war, equipment that had been installed by paper mills for pulping esparto was used for pulping straw, and consumption rose to 353 000 tons in 1945. In 1955, however, it had fallen again to 129 000 tons and it is clear that it will not increase unless the marketing problem can be solved. Not surprisingly farmers are unwilling to expend labour on harvesting more straw than is needed on the farm unless they are sure there is a market for it. The difficulty is that the price which the paper makers are prepared to pay for straw depends on the price of wood-pulp, and since wood-pulp prices have, in the past, been subject to wide fluctuations (and even in the last three years have risen substantially) it has been difficult to fix forward prices for straw.

7. However, the amount of pulp we need to buy from abroad is so large that while waste paper and straw could form useful substitutes for imports, even if they were exploited to the full they would not preclude the possibility of the economic development of a domestic wood pulping industry.

APPENDIX V

WOOD-PULP IN THE COMMONWEALTH AND COLONIES

COMMONWEALTH

1. *Canada*, with her million square miles of forest, half of which is classified as " accessible ", is (with the exception of New Zealand) at present the only country of the Commonwealth and Colonies which exports wood-pulp. Her exports, which exceed 2¼ million tons per annum, are the world's largest. Since the output of the Scandinavian forests is approaching the limit imposed by the need to operate them on a sustained yield basis, Canada's importance as an exporter of pulp is likely to increase. Provided her forests are conservatively managed, she should continue to be a major supplier of pulp for many years. But whether Great Britain can depend on Canadian supplies will depend on the trend of consumption in the United States, which is Canada's main market. The " Paley " Report of 1952 considered that imports of Canadian pulp and paper in 1975 would be very little different from the quantities imported in 1950. If this prognostication proves true, Canadian pulp should be available for the United Kingdom. On the other hand since payment has to be made in dollars, our ability to buy depends more on the balance of our trade with the dollar area, than on physical limitations of the Canadian supply.

2. *New Zealand* has recently embarked on a programme designed to expand her pulping capacity. The pulp is produced from 800 000 acres of introduced pines planted in the period 1920-30. There is now a small exportable surplus, but the natural market for any surplus is the South Western Pacific.

3. *In Australia* wood-pulp is produced from indigenous hardwoods such as eucalyptus species, and from introduced pines. Production amounts to only about two-thirds of domestic requirements. On present showing there is little likelihood that Australia will ever have an exportable surplus.

4. *In South Africa* considerable areas of forest and scrub have been lost over the last two centuries through over-cutting, grazing, native cultivation and fires. Wood-pulp production, chiefly from wattle, is at present small, but capacity is being increased. An interesting and important development, is the proposal to produce rayon pulp at Durban from plantations of " Eucalyptus saligna ". In the Usutu forests in Swaziland about 118 000 acres in all are to be planted with exotic pines, and about 69 000 acres had been dealt with by 1955. Preliminary work on the pulping qualities of these pines is also in progress. Another project involving large-scale growing of exotic pines in Swaziland, is for the manufacture of special chipboard.

COLONIAL SUPPLIES

5. As hardwoods are successfully pulped in the U.S.A., Europe and Australia, we have considered the possibility of obtaining cellulose pulp from the tropical hardwoods of our Colonies. Used alone, hardwood pulp is less satisfactory for paper making than softwood pulp, and when supplies are freely available it is in lesser demand and commands a lower price. In view of this, as well as other economic hazards that arise in exploiting native tropical hardwoods, we have concluded that rather than encourage the use of such hardwoods, it is better to advocate the planting of stands of quick growing softwood and/or selected hardwood with good pulping characteristics. Such a

policy offers better possibilities of planned output of timber as well as of siting plantation and mill to give the optimum conditions for economic working. In practice there is, however, no immediate prospect of obtaining pulp for use in the United Kingdom from our Colonies.

The general remarks in paragraph 99 concerning the size of mill for the economic production of pulp for the world market apply as much to the Colonies as elsewhere. It is worth recording, nevertheless, that a smaller integrated pulp and paper mill producing some 2000 tons of paper per annum from indigenous raw materials is in an advanced stage of development. It appears to offer Colonial territories, with only a small annual consumption of paper of all grades, the possibility of (i) meeting their own requirements of paper, and (ii) embarking on an industrial venture in which the capital costs and demand on local resources for fuel, water, chemicals and effluent disposal would be comparatively small. Advantage could be taken of relatively small isolated sources of fibrous raw material which would be insufficient to supply a larger mill.

APPENDIX VI

EXAMPLES OF INTEGRATION OF FORESTRY AND AGRICULTURE

A. "STRATHOYKELL"

1. With the support of the Advisory Panel on the Highlands and Islands, the Department of Agriculture for Scotland and the Forestry Commission decided that a series of concurrent surveys should be made of selected areas of hill land in the Highland counties, with the object of deciding on a division of the land between forestry and agriculture in an endeavour to increase production, to provide more employment and generally to revive the rural economy. The "Strathoykell" area was selected as the first to be dealt with as it was particularly in need of assistance. It covers the catchment areas of the rivers Oykell and Carron in the counties of Ross and Cromarty and Sutherland, has a small scattered population and an economy based almost entirely on sheep farming. The district was bare and windswept and more forest-cover was badly needed.

2. The surveys were carried out in 1948 and it was found that, of the 250 000 acres examined, there were 2000 acres of existing plantations, 7000 acres of scrub or felled woodland and 26 000 acres of bare land suitable for planting. After considering how best forestry might be fitted into the general agricultural pattern, always taking into account the fact that the aim was increased production from agriculture as well as from forestry, it was finally decided that the bulk of the felled woodland and scrub should be restored to productive forest, and that some 13 500 acres of bare land should be planted. It was estimated that a forestry scheme on this scale might cause a temporary reduction of about 2000 ewes, although this should largely be made good later as a result of the increased shelter and grassland improvement. In addition there should also be an increase of 500 breeding cows. The increase in forestry should ultimately provide work for some 300 men actually in the woods and the housing necessary for these men and their families would lead to the establishment and enlargement of country villages with modern amenities such as electric light which could not be provided economically for the present sparse population scattered through the area.

3. The scheme was started rather slowly, as it was considered desirable that the forestry work should be carried out in a way which would provide steady employment rather than to start with a planting rate which could not be maintained. This policy also ensured that the change from agriculture to forestry would take place gradually; and farmers would have time to adjust the management of their grazing with as little disturbance as possible.

4. Considerable progress has been made. Terms of purchase for forestry have been agreed for 9500 acres and, of these, 4054 acres have already been planted. The number of men employed by the Forestry Commission in the area in September 1954 was forty-seven and the Commission has built or reconstructed thirteen houses for its workers. The County Councils of Ross and Cromarty and Sutherland have also built thirty-four houses which were intended for occupation by forestry workers, but at present, because of the comparatively high rents charged for them, the majority are let to other tenants. Some difficulties in keeping workers are being encountered because of a competition with contractors for the Hydro-electric Scheme at Loch Shin.

5. It is too early yet to assess the effect of the afforestation scheme on the agriculture of the district, but nine comprehensive schemes have been formally approved by the Secretary of State under the Hill Farming Act, 1946, and the Livestock Rearing Act, 1951 and two more have been approved in principle. These eleven schemes cover 105 726 acres and the works proposed are estimated to cost £57 795. Grants of 50 per cent have already been paid on completed works of improvement costing in all over £35 000. Proposals for three more schemes are being considered.

6. Taking the survey area as a whole, the number of breeding cows increased by nearly 350 between June 1947 and June 1954 while numbers of ewes remained about steady. The figures are:—

Livestock in Strathoykell Survey Area.

		June 1947	*June* 1954
Beef	Cows	266	589
	Other cattle	378	630
	Total	644	1 219
Dairy	Cows	118	137
	Other cattle	94	60
	Total	212	197
All cattle	Cows	384	726
	Other cattle	472	690
	Total	856	1 416
Sheep	Ewes	15 933	16 119
	Other sheep	17 929	19 372
	Total	33 862	35 491

B. THE RAY ESTATE, NORTHUMBERLAND

1. This estate, of just under 10 000 acres, was purchased in 1949 for £56 000, subject to the existing tenancies which yielded a rental, less outgoings, of £2800. The land rises from 600 ft to over 1000 ft, the upper parts being exposed especially to the east. The annual rainfall is about 36 inches with snow very prevalent. Some parts have been broken up by mineral working and a good deal, at the time of purchase, was open fell. The estate was suffering from lack of maintenance in almost every respect. There were about 200 acres of woodland, mainly in small conifer plantations intended as shelter belts.

2. One of the objects of the acquisition was to provide land for the Forestry Commission, and a total of just under 2000 acres has been found by careful consideration of the existing economy and working of the separate farms and small holdings. The area marked out for forestry consists partly of sizeable

blocks and partly of shelter belt extensions. While meeting the requirements of the Forestry Commission for plantable land, the least valuable of the grazing ground has so far as possible, been chosen; and, since the plantations have been sited so as to afford maximum shelter, it is anticipated that in the long run there will be no diminution of grazing capacity.

3. The Agricultural holdings have been rehabilitated and improved by schemes under the Hill Farming and Livestock Rearing Acts: the total " landlord's " costs of these schemes and other capital expenditure amounts to £16 484, and they have resulted in an increase of the rental (despite the reduction in agricultural area) by £788 per year. So far 1264 acres of trees have been planted by the Commission, but the plantations have not yet had time to make enough growth to create effective shelter.

C. THE GRIZEDALE HALL ESTATE

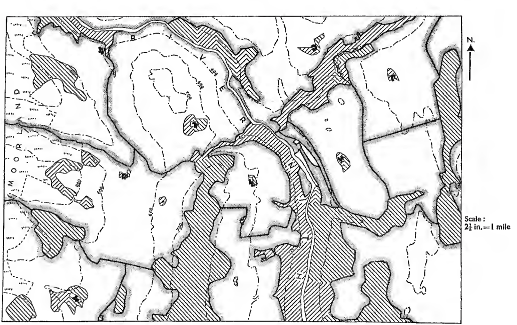
The Grizedale Hall Estate is not strictly an example of integration: since the object has been to afforest all land not definitely required for agriculture. None the less it is of considerable interest as a demonstration of the extent to which agricultural value can be maintained even when, as in this example, 75 per cent of the area previously farmed has been turned over to forestry. The estate, of 4232 acres in all, was purchased for the Forestry Commission in 1937. It then included seven farms comprising 3027 acres, almost wholly devoted to livestock rearing. The Commission has now taken over virtually the whole of the hill grazings for afforestation: the remaining agricultural acreage being 766, a reduction of 2261 acres. Meanwhile, however, the rental value of the farms has actually been increased from £749 (in 1937) to £984 (in 1953). Even after making discounts for landlords, improvements, and for the general rise in the level of agricultural rents, the rents at present (1953) receivable are equivalent to four-fifths of those receivable when the estate was purchased, although the present agricultural acreage is only one-fourth of what it then was. The maintenance of this rental value has been accomplished by some concentration of the best valley land in five farms (in place of seven) and a change over from extensive stock raising to intensive farming, mainly dairying.

D. THE BUCCLEUCH ESTATE

The sketch map opposite illustrates an integrated pattern of forestry and agriculture on the estate of the Duke of Buccleuch in Dumfriesshire.

Most of the area depicted lies from 500 to 700 feet above sea level. The agricultural land is divided into medium sized farms, of around 150 to 400 acres, mainly engaged in livestock rearing and dairy farming. The sale of liquid milk is a comparatively recent development in this area.

The plantations have been sited to utilize ground where the soil is unfavourable to farming or the gradients particularly steep. As an example, the summit of the north-south ridge in the middle of the map is a sub-outcrop of silurian rock thinly covered with a sticky boulder clay: this has provided conveniently for the long plantation which, sited along the ridge, is a most useful shelter feature. The precipitous right bank of the river and the small valleys of the left bank are dangerous for stock: they have therefore been planted, according to aspect and soil, with mixed hardwoods, mainly oak, with some ash, beech and sycamore and conifers such as Norway spruce, larch and Douglas fir.



Sketch Map of Area referred to in Appendix VI D

LEGEND ═ Farm boundaries ▨ Mainly deciduous plantations ▨ Mainly coniferous plantations

Without the benefit of the shelter afforded by the plantations, it is considered that this area might be marginal even for stock rearing, whereas it is now good stock rearing land and much of it is supporting dairy cattle.

Apart from the plantations, most of the farmsteads and individual dwellings are protected by belts of trees. These belts help to make these farms more habitable as well as more productive.

The plantations enable the estate to be self supporting in fencing timber, and to meet a considerable proportion of its needs for timber of other kinds, and also to obtain revenue from sales of pitwood and maturer timber for payment of planting and other forestry expenses.

APPENDIX VII

MAN-MADE TEXTILES

1. Man-made fibres, in general, cost less to produce than the imported natural fibres which they replace. The export value of goods made from cellulosic fibres (i.e. acetate and viscose rayon) is by itself far greater than the cost of the pulp needed to meet both home and export requirements. Rayon is widely used either on its own, or in blends with cotton, wool, silk and flax, and the range of its uses, particularly in the industrial field, is constantly increasing.

2. At present over 90 per cent of total United Kingdom output of man-made fibres consists of fibres produced from cellulose. All dissolving pulp (i.e. the grade of pulp suitable for rayon production) is imported, but as a raw material for textiles its cost is low. Compared with recent average prices of 30, 100 (based on estimated clean-weight yield) and 20 pence per lb for cotton, wool and flax respectively, the cost of imported raw material needed to give one pound of viscose rayon is about tenpence. It is obvious that the further use of cellulosic fibres in place of natural fibres, or to meet increasing demands for textiles, could lead to substantial savings in import costs.

3. The prospects for such increased use of cellulosic fibres are governed by fashion and user preference, as well as by the relative prices of raw materials. These price relationships are not constant. If prices of natural fibres rise there is a greater incentive to develop man-made alternatives as well as scope for greater savings of foreign currency. Cotton prices hitherto kept artificially high by United States price supports have already dropped and in the short run may well fall further. In the long run the trend is likely to be influenced by conflicting factors: higher yields of cotton per acre offer some scope for price reduction, but on the other hand the increase in world population and higher living standards in poor countries will force up the price of the good agricultural land on which cotton is grown. The yields of cotton, even on good land, are comparatively low—240 lb per acre is about the world average—while the yield of rayon pulp from timber grown on land quite unsuitable for an intensive agriculture is considerably higher than this. Thus in Finland, on land which cannot grow food crops, an output of timber equivalent to about 500 lb of pulp per acre per year is obtained, while in the United Kingdom yields equivalent to about 1000–1500 lb of pulp are deemed possible from timber grown on the better class of marginal land. For this reason, the competitive value of goods made from dissolving pulp may well increase rather than diminish.

4. At present all our dissolving pulp is imported, at an average cost of some £73 a ton. In 1955 licences were issued for the importation of 224 000 tons of dissolving cellulose for rayon manufacture alone, at a total cost of over £16 millions. The import savings which rayon already achieves would be notably increased if the pulp from which it is made could be produced at competitive prices from our own forest resources.

5. As noted in the body of the report, under present conditions adverse technical and economic reasons prevent the establishment of a mill in Great Britain for producing dissolving pulp.

6. But the primary reason which rules out, for the present, the possibility of establishing a " dissolving pulp " mill in the United Kingdom is the success

which is now attending a similar project in South Africa. The yield of Eucalyptus saligna grown on short rotation approaches eight to ten tons per acre per year, and is equivalent to well over 2000 lb of dissolving pulp per acre. This is greatly in excess of the likely yields expected from Sitka Spruce grown on marginal land in Great Britain.

APPENDIX VIII

GLOSSARY

Artificial " Boards "

There are a great range of artificial boards, from cardboard, through mill board to building boards. The material and processes used in their manufacture differ somewhat between proprietary makes. Materials include waste paper, textile wastes, wood fibre and other vegetable fibres, binding pastes and in some instances mineral powders. The usual process is for the raw materials to be reduced to a wet pulp, pressed, dried and more or less heavily rolled. More detailed descriptions will be found under the usual commercial terms for the various boards below.

Card and Mill Board

These are familiar articles; they are, in a sense, part of the paper range.

" Chipboard "

The word " chipboard " is used in the trade to refer to two quite distinct and dissimilar products.

(i) A paperboard used for purposes such as cartons, packing materials, etc. This type of chipboard is of low density and is made almost always from waste paper in thicknesses of ·006 in. to ·024 in. It is often laminated after manufacture to form thicker and stronger boards.

(ii) A particle board made from pieces of unpulped wood and other fibrous materials. It is almost always made in batch processes by pressing the material under great pressure in hot presses with synthetic resin binders. No pulp and no water is involved. It is used, in effect, as a thick and strong plywood for which, thickness for thickness, it is a cheap replacement. It is not normally made in thicknesses of less than about ½ inch.

Groundwood or " Mechanical " Pulp

Groundwood pulp is prepared by a mechanical process consisting of forcing wood against a grindstone partly submerged in and sprayed with water. The yield of pulp is high and the cost low. Papers made from groundwood are of low strength and stability. Newsprint normally contains about 80-85 per cent groundwood.

Hard Board

Of much higher density than " Insulation board," the fibre mat being finally rolled under great pressure. It is normally supplied with one smooth face capable of taking polish or high gloss paint; and is used in the building and furnishing trades for panelling, etc. Waterproof versions are made for boat building, etc.

Hemlock

North American (Western) Hemlock, *Tsuga heterophylla*, an evergreen conifer allied to spruce.

Insulation Board

A fibre board of low density used in the building trade for thermal insulation and acoustical control.

Kraft Pulp

The material produced when the sulphate process is applied to coniferous wood.

Laminated Wallboard

The process of manufacture is more akin to that of paperboard than of " Hard board ": laminated wallboard is made from a mixture of waste paper and some mechanical wood pulp. It is used for panelling and partitions, etc.

Lop and Top

Branches and tips of trees removed in the preparation of logs for transport to the saw mill.

Maturity (of timber)

(a) The stage at which a tree is capable of reproducing itself by seed and has attained its full height.

(b) (Management). The age at which a tree or stand will no longer increase in value fast enough to earn a predetermined rate of interest.

" Rayon Staple "

The term used to distinguish rayon filament cut in relatively short lengths for spinning pure, or as a mixture with other fibres, by spinning processes originated for natural fibres. Distinguished from continuous filament rayon.

Round Timber

(a) Felled trees or logs

(b) Prepared timber in the round, e.g. telegraph poles, jetty poles, pitprops.

Saw Log

A log suitable in size and quality for the manufacture of sawn timber.

Saw Timber

Logs suitable in size and quality for the manufacture of sawn timber (synonymous with " saw logs ").

Sawn Timber

Timber sawn to size, with or without wane.

Semi-chemical Pulp

In the semi-chemical process the pulp fibres are separated from one another, without the extensive damage to the fibres that occurs with the groundwood process, by a sequence of chemical and mechanical treatments, neither of which when used alone is sufficiently severe to bring about the separation of the fibres.

Sulphate Pulp

The distinctive feature of the " Sulphate Pulp " process is that the digester liquor contains a mixture including sodium hydroxide and sodium sulphide. The process, which may be applied to both softwoods and hardwoods, is attractive because it gives a pulp in good yield and of high strength. Sulphate pulps can be used for most purposes in paper making. Unbleached coniferous sulphate pulp gives strong papers widely used for wrappings, bags and liming paper board. Bleached sulphate pulp, suitably blended with other pulps, is used for book printing and writing papers. One advantage of the sulphate pulp process is that it is suitable for many broadleaved trees, including tropical species and a number of pines such as Douglas fir and other resinous conifers, which cannot be pulped satisfactorily by the sulphite process.

Sulphite Pulp

Normally made from spruce, true firs, and hemlock (for which see above). The wood chips are digested in an acid liquor containing calcium bisulphite and sulphurous acid. Unbleached sulphite pulp is light in colour, and bleaching to a high degree of brightness can easily be obtained without great loss in strength. Sulphite pulp is used with mechanical pulp (groundwood) in newsprint to increase the strength of the paper. It is also used in all kinds of book and printing papers and in wrapping papers.

The majority of viscose pulps and all the acetate grade pulps are made by the sulphite process. "Dissolving pulp" for the production of synthetic textile fibres is the highest grade of sulphite pulp.

Timber

(a) Categories of wood other than firewood
(b) For statistical records, wood down to a diameter or girth; three inches diameter over bark for small trees in the United Kingdom.

Viscose Rayon

The term used to distinguish the product of the most common process of rayon manufacture from the other "acetate" and "cuprammonium" processes. The "viscose" product is described as a "pure regenerated cellulose."

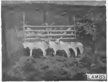
(A) HILL PASTURES IN HIGHLAND BRITAIN (*paras.* 24-27)
Sheep-walks like these would be improved by tree shelter

(B) SHELTER BELTS AND IMPROVED HILL PASTURE (IN MIDDLE DISTANCE) ON THE WELSH BORDER (*para.* 122 (c))

PLATE 1

SHEEP PRODUCTION ON HILL PASTURES

STOCK REARED ON
NATIVE HILL PASTURE



SHEEP DATA, AUGUST 1955

Native Pasture		*Reseeded Pasture*
	LAMBS	
12	Number reared on 10 acres	33
38 lb	Average weight	52 lb
48/-	Average value	75/-
45 lb	Weight of lamb produced per acre	172 lb
57/6	Value of lamb produced per acre	247/6
	YEARLING EWES	
5	Number maintained on 10 acres	8
62 lb	Average weight	72 lb
78/-	Average value	91/-
	EWES	
15	Number maintained on 10 acres	32
67 lb	Average weight per ewe	91 lb
65/-	Average value	88/-
8	Number of lambs reared per 10 ewes	10½

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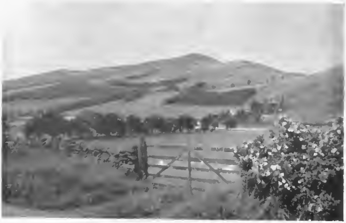
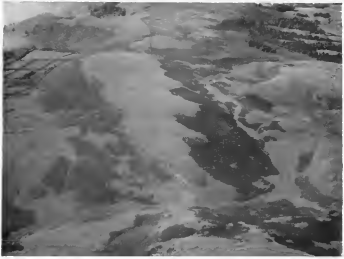
PLATE 2

STOCK REARED ON
RESEEDED HILL PASTURE



(A) BLOCKS AND BELTS OF CONIFERS AND HARDWOODS IN THE TWEED VALLEY PROVIDING SHELTER FOR PASTURES (*para.* 124)



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(B) PLATEAU SHOWING HOW BRACKEN AND GORSE HAVE INVADED THE SLOPES (*paras.* 122 (*b*) *and* 130)

PLATE 3